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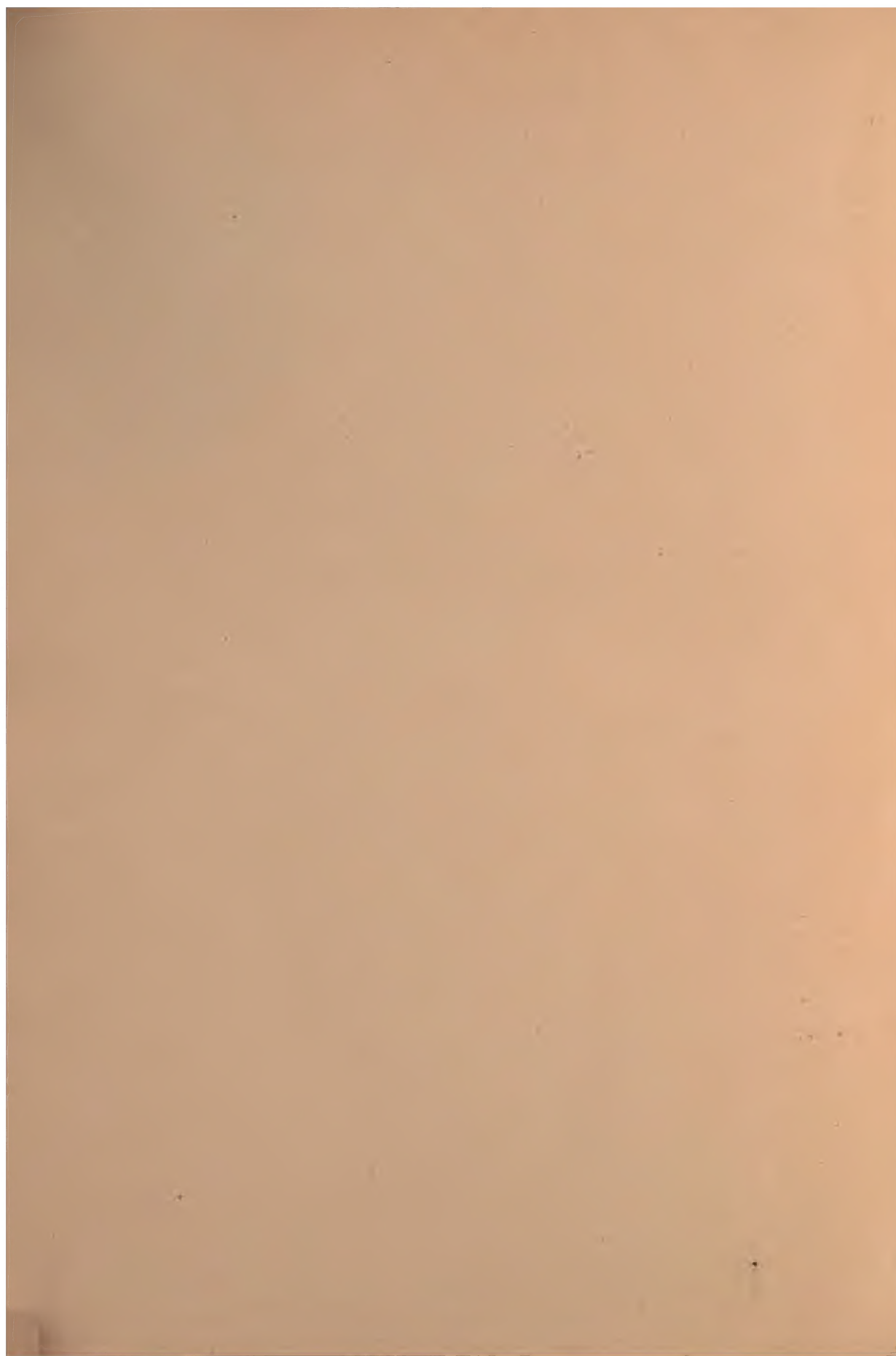


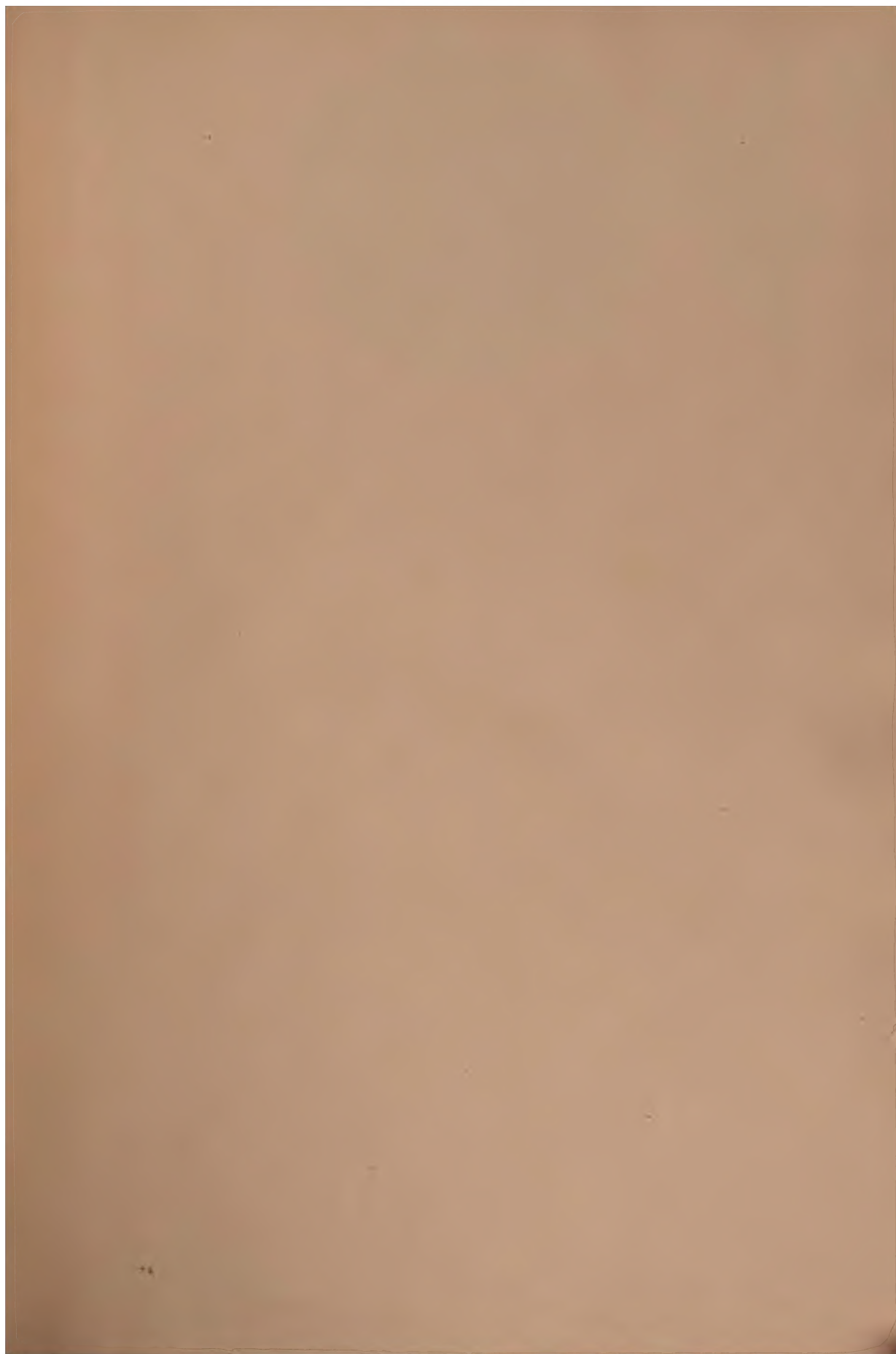
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GYNECOLOGY

AND

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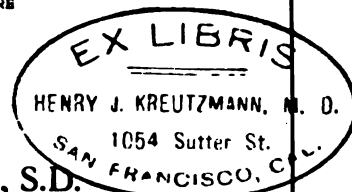
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VOLUME TWO

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GYNECOLOGY AND ABDOMINAL SURGERY.

CHAPTER XXVI. COMPLICATIONS FOLLOWING OPERATIONS.

BY G. BROWN MILLER, M.D.

SHOCK.

Shock has been defined by Gould as "the depression or grave effect produced by severe injuries, operations, or strong emotions; a relaxation or abolition of the sustaining and controlling influence which the nervous system exercises over the vital organic functions of the body. It is the result of a profound impression made on the cerebrospinal axis, either directly through the agency of an afferent nerve, or through the circulation." Some authors consider shock to be a paralysis or weakening of the vasomotor center in the medulla, caused, reflexly, by a disturbance of the sensory nerves. As a result of this weakening of the center there follows a diminution of the tone of the blood-vessels, a weakening of the propelling force, and as a consequence the blood tends to collect in the veins, particularly those of the abdomen. There is a lowering of arterial tension and probably an anemia of the brain and lungs.

The causes of the shock of operations are not thoroughly understood. Prolonged anesthesia and exposure of the patient to cold, excessive loss of blood, and much handling and exposure of the abdominal viscera seem to be the chief causes of shock. The condition of the patient also plays an important part in shock. The seat of operation is likewise an important factor, operations on the liver, gall-bladder, and duodenum being most apt to cause it. It is noticeable in extensive hysterectomies. The time when shock occurs is usually during the operation or within a few hours immediately following it. Many surgeons think that shock may come on several days after operation. This "delayed shock" is very rarely, if ever, seen following surgical operations. The symptoms in these cases are probably due to other things, such as hemorrhage, sepsis, tympanites, embolism, etc.

The symptoms of shock are as follows: Pallor and coolness of the surface of the body, which is usually bathed in a cold perspiration; the pulse is irregular, increased in rapidity, weak and thready; the respirations are irregular, deep and shallow breaths alternating; the mind is dull and apathetic and the special senses are blunted; the face is without expression and the eyes dull and staring, the pupils are dilated and react slowly; the energy of the muscular movements is diminished; there is nausea; the temperature falls 1° to 2° F., and the appearance of the patient is that of approaching dissolution.

Practically the only conditions with which shock could be confounded are secondary hemorrhage and pulmonary embolism. A close observance of the symptoms will usually suffice to differentiate between shock and hemorrhage. A knowledge of the operation and the consequent liability of hemorrhage or shock is very important. A long tedious operation where the intestines were much handled, where the vessels were carefully ligated, and the oozing checked would make one incline to diagnose shock. The detection of the hemorrhage by inspection, palpation, etc., is of the utmost importance. Shock is usually seen before the end of the operation and continues over the few hours immediately following; hemorrhage may begin suddenly at any time within several days. The pulse is different in hemorrhage, growing steadily more rapid and weaker, and the increasing dyspnea and restlessness in hemorrhage aid in the diagnosis. The blood examination is of little value in differentiating these conditions following operation. Pulmonary embolism occurs suddenly, and frequently at a period in the convalescence when one would not expect either shock or hemorrhage.

Following the symptoms usually seen in shock, one at times sees extreme restlessness and almost maniacal delirium. This, as a rule, quickly subsides and may be again followed by depression and by symptoms of collapse. In fatal cases the patients sink into a stupor and the heart stops in diastole.

The treatment of shock consists in vigorous stimulation of the skin by rubbing, dry heat, sinapisms; the head should be low. A stimulating enema of four ounces of hot black coffee; or one of eight ounces of salt solution, thirty grains of ammonium carbonate, and one ounce of whisky, should be given. Hypodermic injections of strychnin $\frac{1}{30}$ gr., repeated if necessary in two hours, are useful. Morphine in repeated small hypodermic injections (gr. $\frac{1}{8}$ to $\frac{1}{4}$) is one of the best remedies we have, especially where restlessness is present. If much blood has been lost during the operation, a saline infusion, 500 c.c. or more, under each breast or into the veins is indicated. Byford thinks that the application of dry heat along the whole length of the patient, especially to the head, is most important. Recovery from shock is indicated by an improvement in the pulse, which becomes stronger and slower, the patient becomes warm, the respirations are deeper and more regular, the color improves, and the expression of the patient is changed for the better. To guard against shock it is most important to prepare the patient well for the operation by building up her general condition, especially the amount of hemoglobin in anemic patients, thoroughly emptying the intestinal tract so as to have the intestines col-

lapsed during operation; to shorten as much as possible the length of time of anesthesia and operation; to minimize the loss of blood; to handle the intestines as little as possible and to protect them by means of warm gauze; and to keep the patient warm during operation. Olshausen says the use of the Trendelenburg position in laparotomies is justified on the ground that it protects the intestines, if for no other reason. When symptoms of shock already exist, as in strangulated hernia, intestinal obstruction, etc., general anesthesia is contraindicated.

SECONDARY HEMORRHAGE.

Hemorrhage following gynecologic operations occurs sufficiently often to make its consideration important. In a considerable number of the cases in which it occurs the hemorrhage is not alarming, and frequently it is only discovered by accident or passes unnoticed. In other cases only a prompt surgical interference can save the life of the patient, and a few unfortunates die before any measures can be taken to check the hemorrhage.

In 7000 operations in the gynecologic department of the Johns Hopkins Hospital there have been 5 cases of serious hemorrhage following laparotomy; 12 cases following perineal operations; 2 cases following vaginal hysterectomy; 2 cases following trachelorrhaphy; and 2 cases after nephrotomy.

The chief causes of secondary hemorrhage today in gynecology may be stated as follows: Ligation or clamping of tissue *en masse*, cutting too close to the ligature or clamp, the untying or stretching of catgut ligatures, the use of suture ligatures, the incomplete checking of capillary oozing during operation, and the loosening of a thrombus or ulceration of the vessel wall by suppurative processes following operation.

In ligating en masse either the vessel may not be sufficiently compressed or the tense tissues may offer so much resistance as to cause the knot to loosen or the ligature to stretch. It is safer not to ligate a considerable mass of tissue, as the pedicle of an ovarian tumor, while it is tense. In placing a ligature close to a clamp which grasps a mass of tissue one should remove the clamp at the moment when the ligature is drawn taut. Large vessels should, if possible, be isolated before being ligated. The stump of the pedicle should project at least 1 to 1.5 cm. beyond the ligature. Whenever large vessels are ligated silk or kangaroo tendon is to be used in preference to catgut, and when the slightest doubt exists as to the safe ligature of the vessel an additional tie should be used. To prevent the untying of catgut it is better always to make several ties in the knot. In operations where suture ligatures are used to control large vessels, as in nephrotomies, myomectomies, and perineorrhaphies, there is an especial liability to post-operative hemorrhage. This is noticeably the case in nephrotomy, where, although the hemorrhage appears to be checked externally, it may continue into the pelvis of the kidney. In a case occurring in the Johns Hopkins Hospital blood-clots forming almost complete casts of the dilated pelvis of the kidney and bladder were found at the second operation,

where the kidney was removed to control the hemorrhage. The reason of this is obvious; the vessels cannot be ligated and pressure by means of suture ligatures is the only means of checking the hemorrhage. Hemorrhage is liable to occur in the repair of a vesicovaginal fistula and the blood escape unnoticed into the bladder. At times, it follows the too early removal of the tampon or clamp.

In considering the time when secondary hemorrhage is liable to occur it is necessary to say a few words about the obliteration of ligated vessels. This occurs either by the formation of a thrombus, or "if the ligature be applied aseptically, and without injury to the internal coats, usually no thrombus is formed or only a small one."¹

In the organization of a thrombus and the obliteration of the ligated vessel in which no thrombus has formed the process is an obliterating angeitis. "There are great diversities in individual cases as to the rapidity of onset and the course of the organizing process, these differences depending upon various circumstances, the most important of which are the location of the thrombus, the condition of the wall of the vessel, the general state of the patient, and the presence or absence of infection. In favorable cases the process may be well under way within a week. The presence of the pyogenetic bacteria delays or prevents the process of organization."

The time when we should expect the hemorrhage to occur in clean cases is, therefore, within the first week. This is really the case. Nearly all of the secondary hemorrhages occur within the first forty-eight hours following operation. In these cases either the hemorrhage has not been completely checked at the operation and the gradual loss of blood makes interference finally necessary, or in the violent struggles in semi-consciousness and the muscular efforts made in vomiting when the patient is recovering from the effects of the anesthetic and the shock of operation the sutures and clamps are liable to slip. In cases where ordinary catgut is used there seems a liability to hemorrhage at the end of five or six days, at which time the catgut has lost its strength. In post-operative hemorrhage due to sepsis the bleeding may occur at any time, but is usually after several days.

Symptoms.—The symptoms of secondary hemorrhage are those of hemorrhage in general, but may be, in certain cases, masked by those of shock, sepsis, intestinal obstruction, and other complications. In making a diagnosis of secondary hemorrhage we are naturally influenced by the nature of the operation, by the manner in which the operator ligated the vessels and checked capillary oozing, and by many other circumstances which common sense will suggest in individual cases. The symptoms upon which we depend are as follows: To be able to detect the loss of blood by actual observation or by pelvic examination; continuously increasing rapidity of pulse-rate with a corresponding diminution in the volume; increasing pallor; quickened, sighing respiration, and, finally, marked dyspnea; cold, clammy skin and extremities; vertigo; restlessness; precordial distress; vomiting; and pain at the seat of operation.

¹ Welch, W. H.: Allbutt's "System of Med.," vi, 165.

The blood examination is of considerable value in some of these cases. The microscopic examination of the blood may not show it to be greatly changed. All of these changes in the cellular elements are those which are found following an operation where there is considerable loss of blood. It aids in differentiating hemorrhage from sepsis, pneumonia, and those complications in which one finds a high leukocytosis.

The typical picture of a patient who is having a secondary hemorrhage depends upon the rapidity of the hemorrhage. In those cases in which a large vessel is bleeding the patient may die in so short a time as to make an observation of all of the above symptoms impossible. In these cases there will be sudden sharp pain, with rapidly increasing pulse-rate, extreme restlessness, cold perspiration, increasing dyspnea, and death. Kelly¹ depicts a typical case as follows: "The patient begins by complaining of pain in the lower abdomen; her color seems a trifle paler and the pulse somewhat quickened. The pain comes on in paroxysms and is somewhat diffused. She wears an anxious expression and she may insist on seeing the doctor at once, fearful that she is not doing well. The radial pulse quickly becomes diminished in volume, while its rhythm is increased from twenty to thirty or more beats; the legs and arms become cold as the hemorrhage continues, and the radial pulse finally fails altogether or becomes so faint that it can be detected with difficulty. The physician, arrived at the bedside, feels no pulse at all unless it is the pulsation of his own finger-tips as they are pressed deep into the wrist in his anxiety to discover some faint beats. The face assumes an ashen hue, the conjunctival mucous membrane is no longer injected, the lips are blue, and the gums blanched. A cold perspiration breaks out on the face and the respiration is quickened and labored. The temperature is subnormal. She lies flat on her back with her chin elevated to make the breathing less difficult, and although restless and anxious, remains motionless except an occasional tossing of the head from side to side as the dyspnea increases. She knows that her condition is changed, but often does not appreciate the gravity of the situation. The accessory muscles of respiration come into play toward the last and she complains of a painful or heavy sensation in the cardiac region. This is apt to signalize heart failure. With the increasing dyspnea comes a sense of suffocation and a desire to have the head raised with pillows beneath the shoulders. The distress and half articulated gasping request of the patient at this time are particularly distressing to the bystander. The heart impulse may still be distinctly felt, regular but sudden, short, and violent, over the precordium. Gradually as life ebbs away the pupils dilate and a condition of apparent unconsciousness supervenes, although this state may occasionally be interrupted by a hurried, gasping ejaculation, showing that some consciousness still remains. Complete unconsciousness gradually comes on, the breathing becomes short and gasping, the corners of the mouth are drawn out in a hideous grin, when at last, after one or two shallow, gasping efforts, respiration ceases altogether. The heart continues to beat some time after respiration has

¹ Kelly, H. A.: "Operative Gynecology," 1898, ii, 65.

ceased, and after the pulsations are no longer felt a slight tickling or faint contraction, more or less rhythmic, may be detected for a minute or more, and the tragic scene is at an end."

If the loss of blood is excessive, death results from lowering of the arterial pressure. The amount of blood which a patient can lose and survive varies greatly with the individual case. A sudden loss of three or four pounds may cause death, where if the hemorrhage be gradual two or three times that amount may be lost and the patient live.

Treatment.—In sudden profuse hemorrhage practically nothing can be done, as the patient may die in fifteen to twenty minutes. In any case the attempt to check the hemorrhage should be made just as soon as the diagnosis is made. If the hemorrhage is gradual and the diagnosis is made before the patient is in too critical a condition, she should be taken to the operating room. If absolutely necessary, the operation may be done in the ward. Cases also in which application of a tampon will check the hemorrhages may be treated in the ward. In operating in the ward the want of the necessary instruments and conveniences, the bad light, and the bad technic make the liability of sepsis and the want of thoroughness of the operation unavoidable. Having removed the patient to the warm operating room with as little excitement and movement as possible, the patient is placed on the operating table and the dressings removed before she is anesthetized. A hypodermic injection of one-sixth of a grain of morphin prior to her removal from the ward will do much toward quieting the patient. The anesthetic should be begun while the dressings are being removed, anesthesia being in most cases unavoidable. While the patient is being anesthetized the wound is rapidly sponged off with alcohol, corrosive sublimate solution, and water. If no suppuration has occurred or if it is within forty-eight hours after the primary operation, separate the adherent edges of the old wound, removing the sutures as may be convenient. In case of suppuration it is better to make another incision or to cut out the old wound, as the liability to peritonitis is increased by the blood in the abdominal cavity and by the anemia of the patient. Go at once to the points where the hemorrhage is apt to have occurred, isolate the bleeding vessel, and ligate it. It is, at times, necessary to clamp the point or points of probable hemorrhage until the pelvic cavity is so freed from blood that one can see clearly the field of operation. In case of nephrotomy if the patient is in a critical condition and the other kidney is acting well, it is generally safer to remove the kidney. After making sure that the bleeding vessel is tied, wash out the blood-clots with warm salt solution and close the wound by the most rapid method. In cases of oozing it may be necessary to tampon. Occasionally hemorrhage following plastic operations or nephrotomy may be checked by the pressure of a tampon, but in the large majority of cases it is safer to open the wound or at least to apply additional sutures. Noble believes the hemorrhage comes from the endometrium in most of the cases which follow plastic operations on the cervix or vagina, and finds tamponing effectual in checking it. It is the rule not to give saline infusions, stimulants, etc., until the bleeding has ceased. However,

it is at times necessary to give the infusion, etc., prior to the operation on account of the weak condition of the patient. During and after operation much care should be taken that the patient be kept warm. Her limbs are wrapped loosely with warm flannel and hot-water bags are placed around her. One should remember the tendency of the tissues to slough in these cases where extreme anemia exists, and should, therefore, be careful that the hot bags do not injure by coming in contact with the patient's skin. The foot of the bed may be elevated and hypodermic injections of brandy, strychnin, digitalis, etc., given. A stimulating enema of four ounces of strong coffee, along with a saline infusion beneath the breasts, is very effectual in combating the shock and immediate effects of secondary hemorrhage and of the second operation.

Following the hemorrhage the watery constituents of the blood are quickly restored by absorption from the gastro-intestinal tract. The same may be said of albuminous elements. The hemoglobin and the red blood-corpuscles require considerable time to reach the normal. In the treatment of the anemia our chief agents are good food and fresh air. Iron, arsenic, strychnin, the bitter tonics, etc., are aids. Bland's pills and Fowler's solution—10 to 15 grains of the former t. i. d., and three drops of the latter, increasing it a few drops each day until the patient takes 10 to 15 drops t. i. d.—have at times a wonderful effect in restoring the red corpuscles and hemoglobin to the normal. In a case in the Johns Hopkins Hospital where the anemia resulted from menorrhagia due to myomata, the hemoglobin in three weeks was increased from 19 per cent. to 48 per cent. by means of these remedies.

POST-OPERATIVE VOMITING.

Nausea and vomiting, more or less pronounced, follow nearly every operation in which general anesthesia is employed, and also frequently accompany or follow operations in which spinal or local anesthetics are used.

The causes of post-operative vomiting may be divided into: (1) those pertaining to the anesthetic, (2) those pertaining to the stomach and intestines, and (3) those pertaining to the general condition of the patient. The anesthetic causes vomiting directly by its irritant action on the vomiting center, and by saturating the secretions of the nose and throat, these being swallowed and thus irritating the stomach. Indirectly it may produce vomiting by producing shock and by its action on the kidneys. The foregoing statement seems to be borne out by the following well-observed clinical facts: *i. e.*, vomiting which occurs frequently just before the patient becomes profoundly narcotized is doubtless due to its action on the vomiting center; in cases where there is a great accumulation of mucus and saliva during the anesthesia, vomiting is apt to be excessive; where the patient is markedly cyanosed, where large quantities of the anesthetic are used, where shock is marked or there is partial or total anuria, vomiting is also liable to be excessive.

The causes pertaining to the stomach and bowels are chronic gastric catarrh, dilatation of the stomach, where the stomach and the bowels have not been emptied

prior to operation, and where there is interference with normal peristaltic action. Thus we see, as a rule, marked vomiting after operation in patients upon whom emergency operations are performed, where there is much handling and trauma of the intestines during operation, in operations upon the gall-bladder and bile-ducts, or where from any cause there is an obstruction to normal peristalsis by reason of local peritonitis, drains, or adhesions.

The causes pertaining to the general condition of the patient relate to the conditions of elimination; to the absorption of certain toxic substances, such as iodoform; to neuroses; and to idiosyncrasies.

When vomiting is excessive and persistent it may be a very formidable post-operative complication. It may follow all attempts to swallow food or water for several days after operation. The violent retching is very exhausting to the patient and, at times, causes the wound to burst open or secondary hemorrhage to take place. As has been stated under *tympanites*, it is most important to differentiate cases of nausea and vomiting unassociated with *ileus* and *peritonitis* from those where they are symptoms of these affections. When vomiting is a symptom of intestinal obstruction, one sees with it tympanites, intermittent abdominal pain, intestinal peristalsis, inability to pass feces or gas from the anus, an increasing pulse-rate, and, finally, if the obstruction is complete, fecal vomiting. When associated with an increase of pulse-rate, elevation of temperature, tympanites, severe abdominal pain, and muscle spasm, vomiting usually indicates peritonitis.

Treatment.—Before formulating any method of treatment one should endeavor to ascertain the cause of the vomiting. In cases of *ileus* and *peritonitis* the treatment is directed toward the cause and is given in the sections on these affections. If not due to these complications the treatment consists in giving the stomach a complete rest for several hours, food being given by the rectum, and medicine and water by the rectum and beneath the skin. Internal medication is usually of little service, although many drugs have been recommended. Cocain, 2 per cent. solution in ten-minim doses, is perhaps useful. Bismuth subnitrate, the tincture of capsicum, and other drugs are at times given. A mustard plaster applied to the epigastrium until decided redness is produced is useful. *Gastric lavage* frequently gives prompt relief, especially in cases where there has been a flow of bile into the stomach or where the stomach is much dilated. This is advocated by some as a routine procedure immediately after all prolonged anesthetics while the patient is unconscious. It is easily carried out and is quite effectual in preventing vomiting. One of the chief indications is to get a satisfactory evacuation of the bowels, which may be accomplished by means of minute doses of calomel followed by enemata, or, in cases when the stomach will tolerate nothing, by enemata alone. A saturated solution of Epsom or Rochelle salts (four ounces) given high (with the object of having it absorbed), followed in a few hours by the usual enemata, is generally effective in causing a free evacuation. Enemata of a solution of alum are very effectual in producing the same results. In some cases in nervous women with irritable stomach the ingestion of food will put an end to constant nausea. If in

spite of all treatment the vomiting is persistent, especially when there are eructations of gas, one should suspect some form of ileus

Hematemesis is occasionally seen following operations upon the abdominal viscera. It may, of course, be the result of an imperfect application of the sutures in operations upon the stomach or small intestines. The *causes* of the affection not dependent upon the above-mentioned condition are varied, but in considering hematemesis as a post-operative affection, one can usually regard it as due to one of two conditions: viz., (1) thrombosis or embolism, and (2) toxemia.

Thrombosis of the omental vessels, which is generally produced by ligation, twisting, or injury of the omentum, may lead to embolism into the stomach wall. Necrosis with subsequent ulceration ensues, producing the hematemesis. Thrombosis or embolism of the mesenteric vessels, by causing necrosis of the small intestines, may likewise cause the vomiting of blood.

In cases of sepsis, especially acute peritonitis, and in mechanical ileus, toxemia plays an important rôle in the production of hematemesis. The manner of its production is imperfectly understood. In the majority of cases there are no gross lesions of the stomach or intestinal wall, the blood seeming to exude from the unbroken mucosa.

The fact that hematemesis follows an operation should not prevent us from considering other causes of the condition, *i. e.*, those not dependent upon the operation, as the hematemesis may accidentally *follow* the operative procedure. These causes may be briefly stated to be: cancer; ulcer; aneurism; varicose veins; acute congestion, as in gastritis; passive congestion due to obstruction of the portal circulation, as in cirrhosis of the liver, thrombosis of the portal vein, chronic disease of the heart and lungs, disease of the spleen; the poisons of the specific fevers, as smallpox, measles, yellow fever; poisons of unknown origin, as acute yellow atrophy of the liver and purpura; the results of phosphorus or of corrosive poisons; certain constitutional diseases, as hemophilia, anemia, cholemia; or where the blood comes from the esophagus, pharynx, or nose and is swallowed. The prognosis depends upon the nature of the lesion causing the condition.

The treatment likewise depends, in part, upon the cause. Where this is not known or cannot be remedied, one has to resort to the symptomatic treatment. Lavage of the stomach with a tepid solution of bicarbonate of soda, the free evacuation of the bowels, the free use of the normal salt solution subcutaneously, and the administration of a few drams of water containing adrenalin chlorid, 10 minims to the dram, given every half hour, have been recommended.

TYMPANITES.

This condition arising after operation is more frequently a symptom than a complication itself. When marked, it usually indicates peritonitis or some form of intestinal obstruction. Tympanites is apt to follow laparotomies where the bowels have been imperfectly emptied before operation, and in consequence of this or some other cause receive much handling and trauma during operation.

If the tympany is due to *ileus* there is an increasing rapidity in pulse-rate, obstipation, vomiting, etc. With *peritonitis* these symptoms are usually accompanied by considerable fever. (See sections on ileus and peritonitis.)

The distended intestines pressing upon the diaphragm interfere with respiration, while palpitation and other disturbances in the heart's rhythm are, at times, noticed. The patient is, as a rule, restless and uncomfortable.

The chief indication for **treatment** is to cause peristalsis of the intestines and to produce an evacuation as soon as possible. This is best accomplished by means of an enema of soapsuds, glycerin, and spirits of turpentine, which may be repeated one or more times if the first trial is unsuccessful. It is the rule of many, and a good one, to give the enemata a faithful trial before beginning the administration of purgatives, unless there is some contraindication to their use. If the enemata do not produce the desired result small doses of calomel, Epsom salts, or other purgatives, repeated at short intervals, should be used. The passage of a rectal tube is, at times, useful, and gastric lavage, by emptying the stomach of its gas and other substances, tends to lessen the distention. Eserin has been highly recommended by some in these cases. It can be given hypodermically, the salicylate being the salt usually preferred. Turpentine stupes and the light application of the cautery to the abdominal walls frequently give considerable relief from pain and probably encourage peristalsis. With free evacuation of the bowels, the flatus escapes; the tympany, as a rule, decreases, and finally disappears.

One of the most important and frequently a most difficult question to determine in these cases is, whether the tympany is due to an ileus or not. The fate of the patient, at times, hangs upon the surgeon's timely decision. If after giving the purgatives and enemata a faithful trial, there is no bowel movement and no expulsion of flatus, it is wiser to explore. The passage of flatus in any considerable amount would indicate that the obstruction was at least not complete. Continued nausea and vomiting, intestinal peristalsis, obstipation, and a progressive increase in pulse-rate usually indicate that the tympanites is a symptom of an intestinal obstruction.

PECULIARITIES OF THE PULSE.

Considerable deviations from the normal may exist in the character and rate of the pulse without a known cause. Tachycardia occasionally arises after operation, which is, so far as we can tell, purely nervous in character, and may give rise to serious apprehension on the part of the attendants. In one of our cases the pulse for several days ranged from 160 to 180, and without any discoverable cause. It subsided rapidly and the patient had otherwise an uninterrupted convalescence. In all cases where there is a marked increase in the pulse-rate the patient should be constantly watched and every effort made to discover the cause. While, as a rule, it indicates sepsis, hemorrhage, ileus, phlebitis, etc., there are accompanying symptoms in all of these conditions which must be present before a diagnosis can be made. Any operative interference would be unwarranted upon this symptom alone.

Brachycardia rarely follows gynecologic operations.

Intermission and other irregularities in pulse arise rather often after operation, and their significance is at times very difficult to determine.

As in tachycardia, there are generally other symptoms whose existence enables us to make a correct diagnosis of the affection.

Pericarditis.—As a post-operative complication pericarditis is a rare complication in gynecology. Practically, it is only seen in cases of septicemia, pyemia, and post-operative pneumonia.

Endocarditis may arise following operation, as a result of erysipelas, septicemia, pyemia, pneumonia (post-operative), and gonorrhea.

The symptoms, diagnosis, and treatment will not be discussed here.

DIARRHEA.

This condition is occasionally seen after operations. It is frequently a symptom of uremia or of sepsis. At times, it is caused by exudates which lie adjacent to the gut and irritate the bowel or cause increased peristalsis. It may be due to an inflammation of the bowel produced by local conditions or by irritating discharges, such as pus, through a fistulous tract. Some cases are inexplicable. One case which I saw, followed the removal of a large retroperitoneal tumor, and finally caused the death of the patient. Fecal impaction and poisoning by drugs, at times, cause the condition. It is not infrequently associated with an inflammation of the pelvic structures, kidneys, bladder, etc., due to tuberculosis. The lesion is then a tuberculosis of the intestine. Most cases are due to an acute gastro-enteritis caused by improper food, etc.

Treatment.—When the diarrhea is caused by sepsis or uremia, no effort should be made to check it unless the patient is becoming too much exhausted. In cases of fecal impaction, poisoning by drugs, etc., the removal of the cause will generally cure the condition. In most cases a proper regulation of the diet, subnitrate of bismuth, opium, and the usual remedies are indicated. One of the most satisfactory remedies is an enema of 10 to 40 drops of laudanum in 3 or 4 ounces of thin, warm solution of starch. This will usually check the movement and give the patient several hours' sleep. In those cases where an abscess opens into the intestine nothing will effectually check the diarrhea until the suppuration is cured.

BED-SORES.

In emaciated and weak patients unless great care is exercised bed-sores are apt to result. After their formation they are, as a rule, very troublesome to heal, and occasionally cause the death of the patient. To prevent their occurrence the patient should be turned frequently in bed, the bandages and dressings inspected sufficiently often to keep them smooth, the utmost care exercised to keep the patients clean and dry, and the skin over the points of greatest pressure hardened by

frequent rubbing with dilute alcohol. Air-cushions or pillows properly arranged are very useful in preventing undue weight on the points of greatest pressure. After the sores have formed they should be kept clean and dry, all pressure removed from them, and they can be dusted frequently with a powder of iodoform and boric acid, calomel, or bismuth subnitrate. In intractable cases the continuous bath is useful in promoting healing.

OPHTHALMIA.

The habit of testing the conjunctival reflex by touching the conjunctiva with the finger, as practised by some anesthetists, is responsible for many cases of post-operative ophthalmia. Carelessness in not protecting the eyes of the unconscious patient from the anesthetic, mucus, vomitus, and other substances, likewise is the cause of a number of such cases. It is quite conceivable that a gonorrheal ophthalmia may be caused by the finger of the anesthetist who has examined gynecologic cases shortly before the operation, and whose hands have not been properly cleansed before he administers the anesthetic. The occurrence of the affection as a post-operative disease usually means carelessness or ignorance on the part of the assistant who administers the anesthetic or the nurse who has charge of the patient while she is unconscious.

The affection is usually mild and gets well promptly under appropriate treatment. The secretion, when purulent, should be examined microscopically without delay, as the preservation of the eye may depend upon the discovery of the gonococcus when that microorganism is the cause of the disease.

The treatment in the mild cases consists in frequent irrigations of the conjunctiva with a boracic acid solution, with or without the instillation of a weak astringent. For the treatment of gonorrheal, diphtheritic, and other grave forms of the disease the reader is referred to treatises on these affections.

PAROTITIS.

Among the complications which may be met with after operations upon the abdominal or pelvic organs is parotitis. The etiology of the affection is not at all well understood, the same condition arising, at times, in diseases or derangements of these organs when no operation has taken place. In the post-operative cases bruising and injury of the gland may arise from forcible and ill directed efforts on the part of the anesthetist to keep the lower jaw forward, and thus predispose to inflammation and suppuration of the gland. In these cases the bacteria may gain entrance through Stenson's duct or through the circulation, the lowered resistance of the gland enabling them to produce pathologic changes. At times parotitis appears to be a part of a septicemia. Another theory, which has been advanced by Dalche, and more recently by Dyball, is that the parotitis is due to the action on the gland "by toxic substances absorbed into the blood and derived from (a) the secretions of certain organs modified by injury or disease; (b) toxins of microbic

origin (*e. g.*, *bacillus coli*) absorbed either from the alimentary tract, peritoneal cavity, or bladder; (c) products of deranged digestion."¹ Others believe that it is a sympathetic inflammation due to reflex nervous action, and in support of this theory cite cases of orchitis, etc., complicating mumps.

The largest number of cases seem to arise after the removal of cystic ovaries and ovarian cysts. In about one-third of the cases the disease is bilateral, the process arising in one gland, and is followed in twenty-four to forty-eight hours by inflammation in the other one. Bonney² states that in the greater number of cases the inflammation subsides without suppuration, but in patients who are weak and feeble the whole gland may slough. As a rule, the affection does not cause much constitutional disturbance, there being a slight rise of temperature, pain, and difficulty in eating. In one of Paget's cases and in a case reported by Dyball the parotid affection seemed to be responsible for the death of the patient. Where there is gangrene and extensive suppuration, the complication is serious.

The **treatment** consists of a liberal diet and stimulation, painting the skin over the gland with belladonna, hot fomentations, and if suppuration occurs the gland should be freely incised.

ACID INTOXICATION.

The importance of intoxications with acids that are produced in the organism in diabetes is generally recognized. It has been shown that this condition of acid intoxication may occur in such conditions as carcinoma, grave anemia, infectious diseases, and gastro-intestinal disturbances. Edsall³ found this condition present in a few cases of *recurrent* or *cyclic vomiting* in children. Kelly⁴ reported 46 cases from the surgical wards of the Boston City Hospital where the condition of aciduria or acetonuria existed. In 12 of the 46 cases it was observed within twenty-four to forty-eight hours after the administration of a general anesthetic; in 17 cases the symptoms were present on their admission to the hospital; and in the remaining 17 cases the condition developed after admission without any assignable cause.

The importance of this condition of acetonuria occurring after operation is sufficiently great to call attention to its chief symptoms. These are the peculiar pungent odor of acetone to the breath; apathy; distaste for food; vomiting; and the presence of acetone and diacetic acid in the urine. Little or nothing is known concerning the cause of the condition or the relation which it bears to surgical affections. The characteristic odor which it imparts to the breath and the urinary tests should make its recognition easy, and now that attention has been called to the condition additional cases will undoubtedly be recognized and studied.

¹ Dyball, B.: "Parotitis Following Injury or Disease of the Abdominal and Pelvic Viscera," *Am. Surg.*, Phila., 1904, xl, No. 6, 886.

² Bonney, W. F. V.: "The After-treatment and Post-operative Complications of Cœliotomy for Pelvic Disease in Women," *Lancet*, Lond., 1899, ii, 337.

³ Edsall, D. L.: "A Preliminary Communication Concerning the Nature and Treatment of Recurrent Vomiting in Children," *Am. Jour. Med. Sci.*, Phila., 1903, N. S., cxxv, 629-635.

⁴ Kelly, James A.: "Acid Intoxication; its Significance in Surgical Conditions," *Am. Surg.*, Phila., 1905, xli, 161-200.

The treatment is largely symptomatic. Edsall advises in the treatment of acetonuria in the cyclic vomiting of children large doses of sodium bicarbonate, and believes it has a markedly favorable action. He follows in this method of treatment that advocated generally in the treatment of the condition in diabetes. Kelly thought he obtained the best results from the use of adrenalin chlorid. This was given subcutaneously, 500 c.c. of a solution (1 : 50,000) being given every eight hours.

LATE POISONOUS EFFECTS OF ANESTHETICS.

In 1850 Caspar called attention to the poisonous effects of chloroform. Nothnagel in 1866 proved that chloroform produced fatty degeneration of the liver and heart muscle when injected subcutaneously or when taken into the stomach. Numerous writers have since shown that chloroform tends to produce fatty degeneration of the liver, kidneys, and heart. The subject has recently received considerable attention in America, due largely to a paper read before the American Medical Association by Bevan and Favill,¹ in which they call attention to the action of chloroform and ether, but especially the former, upon "the cells of the liver and kidneys, and on the muscle cells of the heart and other muscles, resulting in fatty degeneration and necrosis, very similar to the effects produced in phosphorous poisoning." The most important conclusions which they arrived at were essentially as follows: That the liver is the organ most often and most seriously affected, and the injury done to the liver cells is in direct proportion to the amount of the anesthetic employed and the length of the anesthesia; that certain individuals exhibit a susceptibility to the anesthetic; that the predisposing causes to the action of chloroform are (a) age, the younger the more susceptible; (b) causes which lower the vitality of the patient, and (c) chronic diseases of the liver and kidneys; that as a result of the degeneration of the liver cells a toxemia is produced which causes a train of symptoms which consist of vomiting, restlessness, delirium, convulsions, coma, Cheyne-Stokes respirations, cyanosis, icterus in varying degrees, and that death is the usual termination; that acetone and diacetic acid, and beta-oxybutyric acid are found in the blood and urine as a result of the toxemia; that ether seldom causes death in this way; that chloroform is distinctly contraindicated in those cases in which there exist conditions which seem to favor the development of this toxemia, *i. e.*, diabetes, sepsis, starvation, hemorrhage, the presence of intoxication from dead material, the presence of fatty degeneration after infantile paralysis and lesions of the liver; that chloroform should not be given to children or in cases where long anesthesia is necessary.

A period of ten to one hundred and fifty hours elapses between the time of the administration of the anesthetic and the appearance of the symptoms.

In Bevan's case other factors enter which could have produced the toxemia and degeneration of the liver and kidney, *i. e.*, there was a streptococcic and staphylo-

¹ Bevan (A. D.) and Favill (H. B.): "Acid Intoxication, and Late Poisonous Effects of Anesthetics; Hepatic Toxemia; Acute Fatty Degeneration of the Liver following Chloroform and Ether Anesthesia," Jour. Am. Med. Assoc., Chicago, 1905, xlv, 691-696.

coccic infection and an ovarian cyst with a twisted pedicle. In most of the reported cases other factors have entered which prevent a definite conclusion that chloroform alone was responsible for the pathologic changes in the affected organs. However, in view of the facts obtained by experiments upon animals it is evident that both chloroform and ether can produce changes in organs essential to life, and that we should limit the length of anesthesia to the shortest possible time consistent with thoroughness in operating. Likewise the amount of the anesthetic and the skill in administering it are most important factors in surgery.

SAPREMIA, SEPTICEMIA, PYEMIA, ETC.

During operations raw surfaces are formed and exposed to the air, the hands of the operator, sponges, instruments, and, at times, to bacteria which are already in the tissues. After operation, such surfaces are frequently left unprotected; blood-clots form in spaces which have been exposed to infection; the peritoneum is exposed constantly to infection throughout operations upon its contained organs; and sutures which pierce the skin are always liable to be the cause of suppuration. In view of these facts, it is to be expected that conditions of the patient will frequently arise after operation which are due to the action of bacteria. The bacteria may develop locally and only their toxic products be absorbed, or they may enter the blood and produce disease by their presence as well as by their toxins.

Before considering the conditions produced by bacteria, it is necessary to say a few words about **aseptic wound fever**. In certain cases where there is a considerable area of raw surface formed during operation, oozing takes place afterward, the blood cannot escape, and the condition arises to which the above mentioned term has been applied. The same condition exists in hemorrhage into the peritoneal cavity after operation. The elevation of temperature which follows the rupture of a tubal pregnancy or any intraperitoneal organ with an outflow of blood is the same as aseptic wound fever. The condition is imperfectly understood, but is supposed to be due to the absorption of some of the products of the blood. The symptoms are those of a mild infection and may subside in a few days without treatment. In other cases it is wiser to evacuate the escaped blood.

In considering **infections** as post-operative complications we may conveniently divide them into the following classes: Local infections with or without marked constitutional symptoms, sapremia, erysipelas, acute peritonitis, and septicemia and pyemia.

Local Infections due to Pathogenic Bacteria.—In this class of cases may be placed stitch abscesses, suppuration of the wound, or any localized infection where only the toxins produced by the bacteria are absorbed. The bacteria which are found most frequently in stitch abscesses and other local infections are the staphylococci. The *Streptococcus pyogenes*, the *Bacillus coli communis*, the *Bacillus pyocyaneus* and others are occasionally found alone, or two or more of these bacteria may occur in the same inflammatory process. The predisposing causes of

these infections are an anemic or weak general condition of the patient, the presence of a blood-clot, and constriction of tissue by means of sutures. A faulty technic is usually responsible in clean cases.

The *symptoms* are not marked and generally make their appearance about the fifth to the eighth day after operation. There is an elevation of temperature, usually not above 102° or 103° F., and slight general disturbance (headache, malaise, anorexia, and thirst). The patient complains of pain at the site of the infection, and upon examination one finds swelling, redness, and tenderness at this point, and on pulling upon the suture or separating the edges of the wound pus makes its appearance. This is usually yellowish-white and odorless. It is at times blood-tinged, and when due to the presence of the *Bacillus pyocyaneus* the pus has a bluish-green color. When the *Bacillus coli communis* or saprophytic bacteria are present, the odor is offensive.

The *treatment* consists in thoroughly evacuating the abscess cavity and keeping it clean. The cleansing may be done with boric acid solutions, hydrogen peroxid, a weak mercuric chlorid solution, etc. The wound should be dressed once or twice daily, a moist antiseptic dressing hastening the healing. Upon complete evacuation of the cavity the symptoms of septic intoxication rapidly subside. The wound heals by granulation, and this can, at times, be hastened by approximating its edges with adhesive strips after protecting the surface with gauze, or rubber protective and gauze.

In some cases where the wound has been closed in layers the skin surface may have healed and pus have formed in considerable quantities beneath. In such cases, when the symptoms of abscess arise, the skin should be incised and the pus evacuated. Unless this is done promptly the pus may burrow toward the peritoneal cavity and cause extensive intestinal adhesions. A few cases of general peritonitis have been reported which were caused by rupture of such an abscess into the peritoneal cavity. Extensive separation of the wound may also result from such an accumulation.

In hysterectomies for myomata, pelvic inflammation, etc., where the uterus is amputated supravaginally, and in vaginal hysterectomies and other operations upon the uterus and vagina, a parametritis or inflammation of the pelvic connective tissue may result. The symptoms are those of other local inflammations, with frequency of and pain on micturition and painful defecation superadded. The diagnosis of the affection can usually be made by means of vaginal or rectal examination.

In cases of **parametritis** caused by the streptococcus the exudate has a bone-like consistency and frequently small abscesses are found scattered throughout it. The resulting exudate may go on to abscess formation or may be absorbed without any indication of pus.

The *treatment* of parametritis in the acute stages consists in keeping the patient quiet and the usual dietary and other general treatment of inflammation. When pus formation occurs or when a definitely palpable mass is found on examination, which can be reached without exposing the patient to serious danger, it should be

opened freely and drained. The incision may be made through the vagina, above the symphysis, along Poupart's ligament, or through the perineum, according to the situation of the mass. After free incision and drainage the mass usually disappears in a short time. In chronic cases the hot vaginal douche, 5 to 8 liters twice a day, applications of vaginal tampons saturated with boroglycerid solution or 5 to 20 per cent. solution of sulpho-ichthyolate of ammonium, and painting with tincture of iodine are all useful. Pelvic massage is an aid to cure in suitable cases.

A similar condition occurs in retroperitoneal exudates, abscesses, etc., which may accompany or follow cases of appendicitis. When due to the streptococcus the tendency is toward a lymphangitis and not to the formation of a frank abscess.

Sapremia.—When an extensive freshly denuded surface is exposed and decomposing tissue is present, a condition of the patient arises to which the name *sapremia* has been given. The decomposition is due to the bacteria of putrefaction and the symptoms to the absorption of their products. The symptoms are more pronounced in those cases in which this tissue is confined in cavities with a freshly denuded surface. Cases of this kind are seen in puerperal women when a portion of the placenta or blood-clots remain in the uterus and which undergoes putrefaction, and they occasionally arise after gynecologic operations.

The *symptoms* begin suddenly and usually within a few hours after the raw surface has been exposed to absorption from the decomposing tissue. They may arise within a few hours after operation and may not appear for several days. The temperature rises suddenly to 102° or 104° F. and is frequently accompanied by a chill. The pulse is rapid and full, the face is flushed, and the patient complains of headache, thirst, anorexia, and occasionally nausea. The respirations are more rapid, the urine is scanty and high-colored, and the tongue is coated. In severe cases all of these symptoms may be more marked, and unless relief be afforded death may take place in a few days. In other cases a low typhoid condition supervenes and the patient finally dies of exhaustion.

The *prognosis* of this condition following operation is good, and rapid improvement quickly follows the proper *treatment*, which consists in evacuating the cavity thoroughly, irrigating it, and subsequently keeping it clean.

The following was a typical case of sapremia: A young woman who had produced an abortion upon herself entered the hospital, complaining of an offensive bloody vaginal discharge. Pieces of decomposing placenta were found in the vagina upon examination. She was anemic, had a leukocytosis of 9000, her temperature was normal and her general condition was otherwise good. The uterus, which was large, soft, and retroposed, was curetted in order to remove pieces of adherent placenta, and on account of free hemorrhage was packed with gauze and brought into ante flexion. A few light adhesions about the tubes and ovaries were broken up. Six hours after the operation the patient's temperature was 103.6° F., her pulse 160, and she had a leukocytosis of 32,000. She complained of considerable pain in the lower abdomen. The gauze pack was removed, but her condition remained unchanged during the next few hours. On account of the possibility of having punctured

the uterus with the curet or having set free pus by releasing adhesions, an exploratory laparotomy was done. Nothing being found to account for her condition, the uterus was thoroughly irrigated after closure of the abdominal wound. In a few hours she was much better and had no further trouble. Cultures from the uterus were negative. The condition was evidently caused by absorption of the products of decomposition by the freshly cureted surface of the uterus. Saprophytic bacteria were undoubtedly present, but did not grow upon the culture-media used.

Erysipelas.—Erysipelas of the wound is sometimes seen as a post-operative complication. This is an acute inflammation of the skin in the neighborhood of the wound and is caused by the *Streptococcus erysipelatos* (*Streptococcus pyogenes*). The cocci are found chiefly in the lymph-spaces. They may penetrate into the tissue beneath the skin and get into the general circulation. The *cause* is exposure of the wound to the streptococcus. Patients placed in beds previously used by cases infected with the streptococcus, and those whose wounds are dressed without proper precautions as to asepsis, are liable to become infected. Constitutional conditions, as alcoholism and diabetes, are predisposing causes.

The *symptoms* are those of *localized inflammation*, to which is added the characteristic appearance of the skin. There is an itching or burning sensation in the neighborhood of the wound and increased tenderness. The skin is swollen, tense, and red; small vesicles tend to form; and the inflammatory process shows a sharply marked border. In case the disease spreads to the deeper tissues the symptoms are more pronounced. Abscesses form beneath the skin, glands enlarge and suppurate, and in some cases the disease becomes a streptococcic septicemia or pyemia.

The *treatment* consists in applying antiseptic solutions to the wound, bichlorid of mercury, carbolic acid, and other similar remedies being used. In some cases marked improvement has followed the use of the antistreptococcic serum. When suppuration occurs, free incision, thorough cleansing of the abscess cavity, and antiseptic applications are necessary. The general treatment consists in good food, stimulants, etc. Tincture of the chlorid of iron is regarded generally as beneficial. Isolation of the patient is of the utmost importance.

Peritonitis.—Post-operative peritonitis may be divided into two forms: viz., local and general.

Local Peritonitis.—The causes of local peritonitis may be divided into (1) mechanical, (2) chemical, and (3) bacterial.

1. Foreign bodies, such as aseptic sponges, gauze, instruments, etc., blood-clots, pieces of tumor or other tissue, which have been cut off from their blood-supply and left in the peritoneal cavity after operation, all act as mechanical causes of local peritonitis. The adhesions which form as the result of the local peritonitis encapsulate the body, which, if it is sterile and is not secondarily infected from the intestinal tract, blood, etc., remains inert and causes harm only by the adhesions which have formed around it. If infected, it produces either an acute general peritonitis or a localized suppurative process. The latter generally occurs.

2. When the irritating but sterile contents of a cyst or degenerated solid tumor,

antiseptic irrigations, etc., are set free in the abdominal cavity, a local peritonitis generally results, the cause of which may be regarded as *chemical* in its nature.

3. In the large majority of cases where suppuration takes place in the deeper layers of the incision, along the stump of the cervix, etc., a localized peritonitis results, and by the adhesions which form shuts off the peritoneal cavity from general infection. After the removal of an acute pyosalpinx, a suppurating tumor, etc., a localized peritonitis may occur as a result of the local infection. These are but a few examples of the many ways in which bacteria may cause local peritonitis following operation.

Symptoms.—Pain at the site of inflammation is an almost constant symptom. A tumor is in some cases apparent. There is generally some interference with the natural movements of the bowel, and diarrhea, or more often constipation, may be present. Intestinal obstruction is occasionally the result of the adhesions. Encysted fluid can in some cases be made out. Fever is always present when suppuration occurs, and in these cases the symptoms of septic intoxication may be more or less marked. Distention is usually seen, but is variable in amount.

The *treatment* consists in keeping the patient quiet in the early stages and endeavoring to have the process remain local. Opium is of use here and cathartics are contraindicated. Only small quantities of liquid, easily digestible food should be given by the mouth. The bowels can be moved when necessary by means of gentle laxatives and enemata. If a foreign body is the cause of the disease, if suppuration occurs, or if encysted fluid is present, an incision down to the seat of the trouble, through either the abdominal walls or the vagina, is indicated. The operator should be careful to prevent infection of the general cavity of the peritoneum. When the process becomes chronic the adhesions which have formed tend gradually to stretch and separate, and may completely disappear in a comparatively short time. Occasionally it becomes necessary to perform a secondary operation to free the adhesions. The treatment in chronic cases depends largely upon the individual case and consists in vaginal douching, pelvic massage, Swedish movements, general hygienic rules, etc.

General Peritonitis.—The only form of general peritonitis which shall be considered is the acute. This is practically always due to bacteria. One can conceive of cases of acute general peritonitis due to chemical agents, but in practice they do not occur. General chronic peritonitis is nearly always tuberculous in character, a few cases being due to ovarian tumors with twisted pedicles, large myomata, etc. The primary causes of the peritonitis in these cases are mechanical or chemical, the bacterial invasion generally occurring after the adhesions have formed.

Acute General Peritonitis.—Occasionally there arises after operations upon the abdominal organs an acute general peritonitis.

Causes.—Pathogenic or saprophytic bacteria are found in all cases. These may be introduced during operation by the hands of the operator or his assistants; they may come from imperfectly sterilized instruments, sutures, dressings, etc.; they may come from the skin or genitalia of the patient; may be present in localized

abscesses or suppurating tumors and set free during operation; may come from some lesion of the intestine either caused by the operation or arising during convalescence; or may invade the peritoneal cavity after operation from suppurating wounds, through drainage tracts, etc. In 33 cases of fatal post-operative peritonitis reported by Flexner, 25 were mono-infections and 8 were mixed infections. The *Staphylococcus aureus* occurred twelve times alone and twice combined with other bacteria. The streptococcus was found five times alone and four times combined, and the *Bacillus coli communis* occurred three times alone and twice combined. The other microorganisms found were the *Micrococcus lanceolatus*, *Staphylococcus albus*, *Bacillus pyocyaneus*, and *Bacillus aërogenes capsulatus*.

It is generally accepted that a general peritonitis can be caused by the gonococcus. This variety of peritonitis is usually seen prior to operation, but following certain gynecologic procedures, such as curetment, removal of adherent placenta, etc., it may also occur.

Morbid Anatomy.—On opening the abdomen one finds the intestines injected and distended. The amount and character of the exudate are very variable. The exudate may be entirely wanting and the coils show only distention, slight injection, and a loss of luster of the peritoneal surface. Pawlowsky, 1889, and Fraenkel, 1891,¹ proved by experiments on animals that in certain cases of infection by way of the peritoneal cavity death ensued so rapidly that little or no inflammatory reaction of the peritoneum occurred. The exudate may be fibrinous, sero-fibrinous, purulent, or hemorrhagic. In the *fibrinous* form there is a deposit of fibrin on the coils, which are more or less glued together, with little or no fluid in the more dependent parts of the peritoneal cavity. In the *sero-fibrinous* form there is a deposit of fibrin on the coils of the intestine and a large quantity of serous fluid in the abdominal cavity. In the *purulent* form one finds pus in varying quantity, color, and odor in the cavity and on the intestines. In several cases of this kind which I have seen the infection had either begun in the incision or had extended to it. The wound, especially along the sutures, was the seat of suppuration. In the *hemorrhagic* form the exudate is blood-tinged. This is often caused by the oozing which follows the operation. It is seen also in cases of peritonitis following obstruction, hemorrhagic infarction of the intestine, and in certain cases of peritonitis due to saprophytic bacteria.

The character of the exudate is, at times, changed by the contents of the intestine, bladder, etc., which are occasionally found in the peritoneal cavity. The amount of the effusion varies from a few hundred cubic centimeters to several liters. The exudate may partake of the nature of several of these forms. Bumm found in three cases of infection from saprophytic bacteria a foul-smelling, blood-tinged exudate.

Symptoms.—The symptoms generally make their appearance gradually and within twenty-four to forty-eight hours after operation. The pain may be localized

¹ Cited by Engström, O.: "Ueber Darmlähmung nach operativen Eingriffen in der Bauchhöhle," *Ztschr. f. Geburtsh. u. Gynäk.*, Stuttgart, 1897, xxxvi, 399-429.

in the beginning, but soon spreads over the whole abdomen and is intense. It is described as cutting, griping, and tearing, and is aggravated by movements and pressure, and consequently increased by talking, coughing, etc. There is generally great tenderness over the abdomen and the surface of the skin is frequently hyperesthetic. The patient assumes the position which relieves the tension of the abdominal walls, so that she lies with the thighs drawn up and the shoulders elevated. On account of the pain the respirations are thoracic in type. In rare cases pain is not a marked symptom.

In the beginning the abdominal muscles are generally contracted and tense, the abdominal walls being at times retracted. As the disease advances this retraction decreases and the abdomen becomes distended. The tympany is generally excessive, but in a few cases the abdomen is flat throughout the course of the affection.

The pulse becomes very rapid early in the disease, and this is generally the first indication of the trouble. It soon becomes small and wiry. The temperature is variable, but is nearly always elevated. Exceptionally it is but slightly above the normal. It generally ranges between 101° and 105° F., and immediately before death may reach 108° to 110° F.

Vomiting occurs early, is usually persistent, and finally may be fecal in character. It is very exhausting to the patient, partly on account of the severe pain which it causes. The bowels may be loose at first, but are finally constipated. Few cases occur in which a movement cannot be obtained by means of cathartics and enemata. The tongue is coated and finally becomes dry, red, and often fissured. Sordes appear on the teeth. There is intense thirst and anorexia.

The urine is scanty and high-colored and micturition is frequent.

The respirations are hurried and shallow and hiccough is not uncommon. Ascites is usually present and is shown by dullness in the flanks on percussion. This dullness may or may not be movable, depending upon the degree of intestinal adhesions.

A leukocytosis is always present, but the number of the count varies. The value of the sign as an aid in diagnosing this affection from allied diseases has not been settled.

The appearance of the patient is characteristic. It is that of septic poisoning associated with pain. Her face is pinched and pale or slightly jaundiced; her eyes are sunken and staring; her cheeks are hollow, and her mouth remains open. She has a wasted appearance, is anxious, restless, and sleepless. The intellect remains, as a rule, clear to the last.

Prognosis.—The cases of acute septic general peritonitis caused by the *Staphylococcus pyogenes* or the *Streptococcus pyogenes* are almost uniformly fatal. Death occurs in from three to five days. The prognosis in cases of infection coming from the bowel or due to saprophytic bacteria is better, and that of gonorrheal peritonitis is very good.

Diagnosis.—This depends upon the symptoms which have been given. The

only post-operative complication with which it is liable to be confounded is intestinal obstruction, and the differences have been set forth under that heading.

Treatment.—The customary treatment is to reopen the abdomen, evacuate the effusion, thoroughly irrigate the peritoneal cavity, and drain. Great care should be taken to diagnose a local process from a general peritonitis, as in the former case the general cavity, of course, should not be opened. In those cases where the cause of the peritonitis is an opening into the intestine, which is frequently the case after laparotomies for inflammatory conditions, this must be sutured. If the process shows a tendency to confine itself to the pelvis or be local, it is better to cleanse by sponging and avoid contamination of the entire cavity by means of irrigation. The drainage openings should be placed in the most dependent parts of the cavity, as the flanks, vagina, etc. In reopening the abdomen in cases of general peritonitis one usually finds the intestines markedly distended and paretic, so that much difficulty is experienced in returning them to the cavity when they have once escaped from it, or in closing the abdomen without evacuating their contents. Death is hastened and, it may be, caused in certain cases by the absorption from decomposing products of the intestinal contents. Where this marked distention exists it is wiser to evacuate the gas and fecal material by opening a loop of intestine. Moynihan¹ describes under intestinal obstruction the procedure as follows: "The bowel into which the opening is to be made is lightly clamped by an assistant's finger, and a longitudinal incision, about one inch in length, is made in the line opposite the mesenteric attachment. The edges of the wound so made are lightly seized with small vulsellum forceps and are held apart, while a glass tube, about six inches in length, is introduced and passed upward in the lumen of the gut. To the outer end of this tube a long, thick rubber tube is attached, and this leads to a receptacle beneath the table. The tube is pushed gently upward in the distended gut until its outer end reaches the margins of the wound into the bowel. The tube and gut are then seized in a wrap of sterile gauze and held firmly by the assistant so that no leakage occurs by the side of the tube. The surgeon then, with the greatest gentleness, pulls the intestine on to the tube and thereby empties the bowel a little higher up. Gradually more and more of the bowel is pulled onward until as much of it as the tube will take has been emptied. If the whole of the distended gut cannot be pulled upon the tube, a piece of the bowel at the highest point which can be reached is seized, secured by an assistant, and 'milked' steadily downward by the surgeon." The bowel is now closed. In the treatment of post-operative general peritonitis drainage of the intestine itself is thought by many to be as imperative as drainage of the peritoneal cavity. This can be effectively accomplished by the use of the Paul or Mixer tube. After emptying the intestine through a transverse incision at as low a point as is feasible, a glass tube is ligated in each end of the gut, which is brought outside the incision and stitched to it in such a way as completely to shut off the peritoneal cavity. This artificial anus can be closed at another operation should the patient survive.

¹ Moynihan, B. G. A.: "Abdominal Operations," 1905, 381.

Murphy claims such good results in his treatment of diffuse peritonitis that it is well to bring attention to his manner of procedure so far as it is applicable to the post-operative variety. It may be briefly stated as follows: The elimination of the cause of the peritonitis with the least possible handling of the peritoneal contents and in the shortest possible time; drainage of the pelvis by a suprapubic opening; placing the patient in the Fowler position; the absorption of large quantities of saline solution through the rectum; and the prevention of peristaltic movements of the intestines by withholding all foods or liquids by the mouth and the administration of opium if necessary.

Rest is indicated, and any position which will keep the patient most comfortable may be taken. When the infection has its origin in the pelvis or lower abdomen, Fowler's position is indicated. Little food should be given by the mouth, as it excites vomiting. Nutrient enemata should be substituted largely. Thirst is relieved by enemata of the normal salt solution or water 400 to 500 c.c. every four or five hours. Infusions beneath the skin or into a vein are recommended, and are believed to aid in the elimination of the toxins. Turpentine stupes are believed to lessen the pain and relieve distention. Sponging with alcohol or tepid water is refreshing to the patient. The mouth should be rinsed frequently and kept clean. In cases where the bowel is not injured and the process is general, salines are indicated. Enemata of soapsuds with turpentine, milk of asafetida, and glycerin are aids in moving the bowels and in the expulsion of flatus. Strychnin, gr. $\frac{1}{60}$ to $\frac{1}{40}$, every two to four hours, should be given hypodermically, and morphin is generally necessary. In giving narcotics it is a good plan to give as little as possible throughout the day and give a fairly large dose at night, so as to give the patient as much sleep as possible.

The line of treatment varies with the individual case. The principles outlined above are applicable to those cases where it is possible that the infection comes from the bowel, pelvis, etc., and is general. In the hope of keeping the process local, many advise giving opium, so as to stop peristalsis and allow adhesions to form. If one could be absolutely certain of his diagnosis, and that the process was due to the staphylococcus or streptococcus, the latter would be suitable treatment. Acute general peritonitis following operation and caused by either the *Streptococcus pyogenes* or the *Staphylococcus aureus* is perhaps always fatal in spite of all treatment.

Septicemia, Pyemia.—These conditions are caused by the presence of bacteria in the circulation. In *pyemia* local abscesses are superadded. They are closely related and are usually considered together. Both conditions as post-operative complications nearly always have as their source a local infection, although the origin of the infection may not appear externally. The bacteria which are chiefly concerned in post-operative septicemia and pyemia are the *Streptococcus pyogenes*, the *Staphylococcus pyogenes aureus* and *albus*. Indeed, the terms are almost equivalent to such a definition, when considered from a surgical standpoint. Other bacteria have been found, chief among which are the *Bacillus anthracis*,

Micrococcus lanceolatus, gonococcus, *Bacillus coli communis*, and the *Bacillus aërogenes capsulatus*.

The bacteria generally have their portal of entry at the site of the operation or wound, but they may enter also at other points and yet cause infections which occur during convalescence.

Septicemia.—The microorganisms in this condition multiply and generate their toxins not only in the wound but in the blood. No characteristic *post-mortem* appearances have been noted.

The *symptoms* may arise in a few hours or within a few days after inoculation. There is generally a chill, which may be repeated and severe, or only chilly sensations may be felt. The temperature usually ranges from 103° to 105° F., with slight daily remissions. The pulse is small, compressible, and rapid, and the respirations are hurried. Anorexia is present, nausea and vomiting are usually seen, and diarrhea is at times present. The patient is usually lethargic. The tongue is dry, with a dark coating on the dorsum and with red edges; the urine is scanty, high-colored, generally albuminous, and may contain the infecting microorganisms. The skin is generally erythematous in the early stages and later slightly jaundiced, and petechial spots, scarlatiniform rashes, or herpes may appear. The spleen is enlarged and there is a leukocytosis. Blood-cultures usually show the infecting bacteria.

Diagnosis.—The continuance of the symptoms after disinfection of local points of infection will diagnose it from local infections with absorption. Blood-cultures, if positive, are diagnostic of this affection or pyemia. The diagnosis is usually not difficult.

The *prognosis* is exceedingly grave.

Treatment.—The wound should be thoroughly disinfected or excised and kept clean. The treatment otherwise is general, and consists in sustaining the patient's strength with food, stimulants, saline infusions, strychnin, etc. The temperature can be controlled to a certain extent by cool sponging. In streptococcic septicemias the early use of considerable quantities of antistreptococcic serum should be tried.

Anthrax infection, which occasionally occurs after operation, from the use of imperfectly sterilized catgut, is very rare, and the reader is referred to articles on this subject in a treatise on general medicine. Tetanus may occur, but is extremely rare after gynecologic operations.

Pyemia.—This affection is bacteremia, to which are added abscesses in various parts of the body. The streptococcus and the staphylococci are the bacteria most frequently found.

The mode of production of the abscesses is usually given as follows: In connection with a suppurating process, thrombi form in the vessels; portions of the venous thrombi become detached and are carried through the systemic circulation to the lungs or by the portal circulation to the liver; these emboli lodge and produce abscesses. Liver abscess seems particularly apt to follow appendicitis. Endo-

carditis is liable to occur, and the infected emboli from the heart's valves form abscesses elsewhere in the body, as the spleen, the kidneys, the brain, etc. Purulent pleuritis and synovitis are apt to occur.

Symptoms.—More often than in septicemia there are signs of local infection. The disease is generally ushered in with a chill and a rapid elevation of temperature to 103° or 104° F. This is followed by profuse sweating, and the chills and sweating occur irregularly throughout the course of the disease. There is anorexia, nausea, and vomiting. The skin is at first pale and is later slightly jaundiced. The spleen is enlarged and tender. Lesions of the lungs occur and are indicated by dyspnea, cough, and local signs. Pleurisy and pericarditis are frequently present. The patient develops a typhoid condition and becomes rapidly emaciated. When abscess of the liver occurs, icterus is usually present and the liver is enlarged and tender.

Diagnosis.—Blood-cultures when positive are diagnostic of bacteremia. Examination for *Plasmodium malarie* will differentiate it from malaria. Widal's test and blood-cultures are of great value in differentiating typhoid fever from the usual forms of infection. Injections of tuberculin, the history, and lung examination will usually differentiate tuberculosis.

The *prognosis* is usually extremely grave.

Treatment.—The same treatment should be carried out as in septicemia. In addition, the abscesses which can be reached should be evacuated.

INTESTINAL OBSTRUCTION.

Intestinal obstruction is one of the most frequent of the serious complications which follow operations upon the abdominal organs. In 1200 consecutive cases operated upon in the gynecologic department of the Johns Hopkins Hospital and coming under my personal observation, 11 were cases of intestinal obstruction. Five of these cases were admitted with this condition existing, and in the remaining 6 of them the obstruction arose while the patients were convalescing from some operation upon the abdominal organs. In this series of 1200 cases, 770 were abdominal operations. Thus, we had one case of obstruction for each 128 operations in which the peritoneal cavity was invaded.

In by far the larger number of cases of obstruction following operation the condition is caused by intestinal adhesions. After simple operations upon clean cases in which primary union takes place, few or no intestinal adhesions form, but in a very large percentage of the cases where the peritoneal cavity is invaded adhesions do form which involve the intestines. These may arise: from preëxisting adhesions which when separated leave raw surfaces that cannot be covered in with peritoneum; from raw surfaces left as a result of the operation; as the result of a local peritonitis which follows infection, mechanical injury, hemorrhage, etc.; or as a result of infections which occur outside of the peritoneal cavity and by extending toward it cause adhesions. The last condition is illustrated in suppuration of the abdo-

minal wound, parametritis, metritis, suppurative inflammation of the kidney, gall-bladder, etc., where it is owing to the adhesions of the intestines, omentum, and other abdominal organs over the inflamed area that the general cavity is protected from infection. When the adhesions are slight or the gut fixed in a favorable position, the symptoms of obstruction do not generally arise.

Adhesions which follow operations may act in a variety of ways to cause obstruction. Treves makes the following classification:

- (a) Strangulation over a band.
- (b) Occlusion brought about by acute kinking due to traction upon an isolated band or an adherent diverticulum.
- (c) Occlusion effected by adhesions which retain the bowel in a bent position.
- (d) Obstruction by means of adhesions which compress the gut.
- (e) Obstruction by the matting together of several coils of intestines.
- (f) Narrowing of the bowel from shrinkage of the mesentery after inflammation.
- (a) **Strangulation over a Band through an Aperture, etc.**—(I do not include in this class internal herniæ.) In these cases the vermiform appendix, Meckel's diverticulum, an epiploic appendage, or a Fallopian tube becomes adherent by its extremity, and thus forms a band or cord which can compress a loop of intestine beneath it; or the intestine may be snared or constricted by a noose or loop formed by the false ligament itself or by slipping into an opening left in the omentum during operation. Cases of this class are seldom seen immediately following operation.

(b) **Occlusion brought about by Acute Kinking due to Traction.**—In these cases a band of adhesions becomes attached to a portion of the bowel and produces an acute kinking and subsequent occlusion by dragging upon this spot. Adhesions about the pylorus, or dragging upon the stomach by an omentum which is adherent low in the abdominal cavity, by causing a sharp bend near the pylorus may cause an obstruction at this point.

(c) **Occlusion by Means of Adhesions which Retain the Bowel in a Bent Position.**—In these cases the bowel may be adherent to the pelvic or to the abdominal wall, an inflamed tumor or exudate, and offers either a definite obstruction by flexion; or, by causing more or less occlusion and resistance to peristalsis, forms an obstacle to the passage of the intestinal contents. The accumulation of the intestinal contents above this point tends to tighten the kink and increase the obstruction. Finally a complete stenosis occurs and the symptoms of obstruction ensue.

(d) **Obstruction by Means of Adhesions which Compress the Gut.**—In these cases the intestine is adherent to the abdominal parietes or to the pelvic viscera; the adhesions which first form contract and frequently very much lessen the caliber of the gut. These forms of obstruction are usually found involving the more fixed portions of the intestine.

(e) **Obstruction by Matting together Several Coils of Intestines.**—This is perhaps the most frequent cause of post-operative obstruction. The coils may be adherent to each other and to the parietes or pelvic viscera. The small intestine is

usually involved. At times the sigmoid flexure shows this condition, and occasionally the coils of the large and of the small intestine are adherent to each other.

(f) **Narrowing of the Bowel by Shrinkage of the Mesentery.**—In cases where there has been extensive inflammation involving the mesentery, as the scar tissue forms, a very decided lessening of the intestinal caliber is caused by this shrinking. This class of cases is seldom met with as a result of operation.

Another form of post-operative obstruction is **volvulus**. In this form of ileus a loop of bowel becomes attached to the abdominal wall or other structure, or the two ends of a loop of small intestine may be drawn together by a band of adhesions and thus give rise to a pedicle about which a volvulus forms.

Intussusception is perhaps a very rare cause of post-operative ileus.

Separation of the incision and the resulting hernia is an occasional cause of obstruction; and catching a loop of gut with a suture in closing the wound is given by Olshausen as a cause.

Fecal accumulation not due to adhesions following operation is likewise an occasional cause of intestinal obstruction. The accumulation of hard fecal matter in the lower bowel is a not infrequent incident during convalescence. It is especially liable to occur in those cases in which an enema cannot be given, and consequently we see it more frequently following operations upon the rectum, or in cases of complete tear of the perineum.

In the series of the 1200 cases before mentioned, five entered the hospital with an existing obstruction. One of these was a strangulated femoral hernia; one, an acute obstruction due to a band of adhesions; one, a volvulus; and the fifth, an obstruction due to carcinoma. The six cases originating in the hospital were all due to adhesions. One case was due to a condition such as described in (b), and the remaining five to a combination of the conditions described in (c), (d), and (e). The obstruction was complete in five of the six cases.

The time of the occurrence of intestinal obstruction with reference to the operation varies greatly. It may be months or even years after the operation, but as a post-operative complication we are chiefly interested in those in which the symptoms arise during convalescence of the patient. The adhesions begin to form immediately, as a rule, and hence the symptoms of obstruction usually make their appearance within the first two weeks succeeding the operation. In the six cases before noted, the operations to relieve the post-operative obstruction took place as follows: Two upon the third, one upon the sixth, two upon the eighth, and one upon the twenty-third day. In the last mentioned case there was an incomplete obstruction.

In noting the symptoms of obstruction one is struck with the great difference in their intensity in various cases. This is explained by the fact that it is not so much to the occlusion of the lumen of the gut, as to the injury to the intestine and also to the resulting invasion of the peritoneal cavity by the intestinal bacteria, that many of the more pronounced symptoms are due.

As a result of the disturbances of circulation there is venous hyperemia, hemor-

rhage, infarct, edematous infiltration, destruction of the epithelium, and, in consequence, the possibility of the passage through the walls of toxic substances and bacteria. As a result there ensues ulcer formation, peritonitis, etc.

A more important classification of obstructions for clinical purposes is the following: (1) Acute obstruction, (2) chronic obstruction, and (3) acute obstruction supervening upon chronic.

Acute Obstruction.—The principal symptoms of acute obstruction are pain, vomiting, distention, collapse, tenderness, constipation, tumor, and leukocytosis.

The pain usually makes its appearance suddenly and occurs in violent paroxysms. Vomiting begins early, the vomited matter being at first the contents of the stomach, and later those of the intestine. It may or may not be stercoraceous, depending upon the seat of the obstruction, but, as a rule, finally it has a distinct fecal odor. "At times there is hematemesis, which indicates a severe lesion (hemorrhagic infarct) situated in the small intestine."¹ I have noted this symptom in two cases where the obstruction was in the small intestine.

Eructation of gas is a valuable diagnostic sign. Distention begins shortly after the onset of the pain and vomiting, and varies in amount and location somewhat, depending upon the seat of the lesion. When the seat of the obstruction is toward the lower part of the colon, the distention is more marked, and is more noticeable in the flanks than where the small intestine is involved. Tenderness is usually present, being local in the early stages but later becoming general.

Muscle spasm is generally present. Constipation is complete. One is sometimes deceived by the passage of flatus and fecal material in the early stages from the bowel below the seat of obstruction. Collapse, marked in degree, is usually present. This symptom is somewhat variable and cannot be depended upon to indicate the condition of the bowel. Cases are seen which show little depression, and the condition of the intestine is found at operation to be such as to exclude any hope of recovery. One finds, at times, on physical examination a distinct tumor. The temperature is usually subnormal. The urine is usually diminished in amount or may be entirely suppressed, due to an acute nephritis, especially if the lesion is in the small intestine; it contains an increased amount of indican; and frequently acetone and diacetic acid. Increased peristalsis and gurgling may be seen especially early in the disease, but it is markedly less than in chronic cases. Local distention, according to most observers, indicates a volvulus. The greater the pain and the violence of the onset, the earlier the appearance of the distention and vomiting, the more likely it is that the point of obstruction is in the small intestine. The tongue is furred and the breath foul.

Vaginal or rectal examination will at times reveal the distended intestine lying in the pelvis. In one case which came under my observation an examiner mistook the distended loop of intestine for an ovarian cyst.

There may be a leukocytosis. According to Bloodgood, it is usually over 20,000,

¹ Tietze, A.: "Ueber Hämatemesis als Symptom des Ileus," *Deutsche Ztschr. f. Chir.*, Leipzig, 1897, xlv, 17-23.

while Murphy states that there is no leukocytosis in intestinal obstruction. This sign, when present, is of relative value only. So many conditions may arise after a laparotomy which will cause an increase in the number of the leukocytes that the sign is of value only when it is found in conjunction with the other symptoms of obstruction. Leukocytosis is probably always present in the stages of acute obstruction.

Chronic Obstruction.—This condition, which is the most frequent form seen after operation, presents symptoms which differ considerably from those seen in acute obstruction. The picture is usually the following one: After an operation in which the abdominal cavity has been invaded, one finds it impossible to get the patient's bowels to move properly. There are not the free liquid movements and expulsion of flatus which usually follow the customary purgatives and enemata, and finally complete constipation ensues. The abdomen becomes gradually distended. Nausea, vomiting, and the regurgitation of gas, which are usually noticeable from the beginning, increase in persistency and intensity. Visible peristalsis is usually soon apparent, and in patients with thin abdominal walls the coils of intestines are easily outlined and their forcible contraction can be felt and seen. On auscultation there is gurgling over the point of obstruction when there is partial occlusion. The pain, which is not so marked as in the acute cases, is more severe with the peristaltic movements of the bowels. The pulse gets gradually weaker and more rapid. The temperature is not, as a rule, high, but may be slightly elevated, as is usual immediately after laparotomies. The patient is restless and suffers from thirst. Collapse is not so marked as in acute cases, but if interference is delayed the patient soon becomes weak. The urine may be diminished or completely suppressed. The tongue is furred and the breath foul. In many cases the symptoms of obstruction are not at all marked immediately after operation, and all that one notices is a difficulty in moving the patient's bowels, slightly more pain than is usual in such cases, and some distention. As the adhesions become denser and contract the symptoms become more marked, and finally all of the symptoms of obstruction are present. Again, at first the symptoms of chronic obstruction ensue when by a kink in the intestine or accumulation of fecal material the occlusion is suddenly brought about.

In cases of fecal accumulation the symptoms are all less marked. In these cases there is griping pain and the general symptoms of chronic obstruction. When the accumulation is situated in the rectum, there is a feeling of distention and a desire to defecate which is not relieved by the liquid movements caused by purgatives. In those cases where the mass is situated in the true abdominal cavity a tumor is apparent until disguised by the distention. Where the impaction is low, a digital examination will reveal the nature of the condition. After operation when a feeling of fullness, etc., in the rectum is complained of by the patient, a digital examination should be made.

Diagnosis.—It is to be desired, but not usually necessary, to make a diagnosis of the form or the cause of the obstruction. The treatment is the same, and it is, as

a rule, impossible to tell the nature of the obstruction until the abdomen is reopened. Practically the only condition which is liable to be confounded with post-operative obstruction is acute peritonitis, and in both the treatment is an exploratory laparotomy. The distinguishing differences are usually the following: In peritonitis the temperature, as a rule, is higher, there is usually no visible peristalsis, and at first there is contraction of the abdomen, and finally a more general distention, there is less nausea and vomiting, the obstipation is not so complete, the leukocytosis is higher, the tongue is drier and redder, and there is more general tenderness, and more marked muscle spasm. In many cases of peritonitis the effusion into the peritoneal cavity is of extreme value in distinguishing this affection from obstruction.

The prognosis in any case is grave and depends largely upon the time when operative interference takes place. There are few surgical diseases which call more imperatively for an early operation than mechanic intestinal obstruction. If a certain stage is passed the mere relief of the obstruction does not save life. The prognosis is better in the chronic than in the acute cases. Of the eleven cases which have been cited, and all of whom were operated upon, seven died of the affection, one who had typhoid fever as a complication likewise died, and only three recovered. The cases which terminated favorably were post-operative in character and an early diagnosis undoubtedly saved their lives. Treves states that the mortality of the operation for acute obstruction is about 75 per cent., Richardson reports six cases of acute obstruction due to adhesions and bands with a mortality of 50 per cent., while the mortality in our cases (post-operative), after ruling out the typhoid fever case, was 40 per cent., and, counting it, 50 per cent. All of the women who entered with obstruction died; indeed, all were *in extremis* when operated upon.

Treatment.—The prophylactic treatment is most important. The surgeon should in abdominal cases handle the intestines as little and as gently as possible. Injury to the abdominal wall by means of retractors should be avoided. Raw surfaces should be covered over with peritoneum. Extreme care must be used in closing the abdominal wound, the peritoneal surfaces being accurately adapted. Skilful adjustment of the omentum so as to cover in raw surfaces is of much value. The intestines should be arranged as nearly as possible in a normal position, and some, following the example of Clark, fill the abdominal cavity with normal salt solution after operations to allow the intestines to adjust themselves properly and thus prevent obstruction, even though adhesions do form. The early moving of the bowels likewise tends to prevent obstruction.

After the diagnosis has been made, no time should be lost in attempting to relieve the condition. Following vaginal hysterectomy, it is the custom of some in cases where the symptoms arise in the first few days after operation, to attempt to separate the adhesion through the vagina. It is better in any case to do an exploratory laparotomy. It is a good practice, when in doubt, to explore. The inexperienced are almost certain to err on the other side and to wait so long that the patient dies in spite of the relief of the obstruction. Opium may be given after

the diagnosis is made, and warmth and other measures to relieve the collapse are to be recommended while preparing for operation. Infusion of salt solution is very useful in these cases. In making the second incision the same rules hold good as given in hemorrhage. Go at once to the seat of operation, examining carefully also whether the intestines are adherent to the abdominal wound. If the point of obstruction cannot readily be found, it is a good plan to examine first the cecum and see if the distention has extended to this; if not, follow the small intestine back until it is reached. If the obstruction occurs below the cecum and the operation has been upon the pelvic organs, go to the sigmoid, as this is the probable point of obstruction. In some cases it is necessary to eviscerate the patient, but it is better to avoid this if possible, and when necessary the intestines must be covered with warm moist gauze. Having found the point or points of obstruction, the adhesions should be carefully separated and the condition of the gut examined. Where the gut is gangrenous one of two things remains to be done: one can either resect the gangrenous intestine, or bring this portion outside the abdominal cavity and make an artificial anus. The gangrenous gut in the latter case should be stitched to the skin if there is any difficulty in keeping it outside, and opened as soon as adhesions have shut off the peritoneal cavity. The immediate emptying of the intestinal contents is, at times, most important. In cases of great distention, even where the intestine is not gangrenous, the gut should be freely opened and the contents of the intestine allowed to escape. This should be done by bringing a loop of the intestine well outside the abdominal cavity, a transverse incision should be made, and the intestinal contents forced out. The use of the glass tube, as described under Peritonitis, facilitates this procedure. The emptying of the bowel by this means serves several purposes; it allows the decomposing, poisonous contents to escape, it relieves the disturbances of circulation, it allows the intestines to be replaced more easily after operation is over and alleviates the discomfort of the patient. Great care should be exercised in protecting the peritoneal cavity from infection and in closing the opening in the gut. Puncture with an aspirating needle is useless. In some cases where there is no gangrene it may be necessary to resect the gut. After the adhesions have been separated and it is certain that the obstruction is overcome, the intestines are carefully arranged and the abdomen closed either with or without drainage, according to general surgical principles. When the cause of the obstruction is a fecal accumulation the treatment consists in trying to move the mass along by gentle manipulation, enemata, and purgatives. If it is situated in the rectum it should be removed manually, if necessary, after softening it by means of olive oil and soapsuds enemata. Great care should be taken not to break down the wound of the rectum or perineum. In case manipulations, etc., fail to relieve the high fecal accumulation, it should be removed by means of a laparotomy.

Two interesting forms of ileus have been observed which do not depend upon a mechanical obstruction, but which seem due to some abnormality in the nervous mechanism of the bowels.

Paralytic Ileus.—(*Ileus paralitique* of the French.)—Olshausen¹ in 1887 first reported cases of this form of post-operative ileus, and since his report numerous cases have come to light. In this form of ileus, without a definitely known cause the bowel becomes distended and to all appearances paralyzed. Frequently following laparotomies we see distention, which disappears as soon as the bowels move, but in cases of paralytic ileus the distention increases and complete constipation ensues.

The *causes* of the condition are not known. It is regarded as total or partial paralysis of the intestines. Prolonged handling and eventration of the intestines, trauma, injuries of the nerves of the mesentery, and increased intra-abdominal pressure, such as sometimes occurs after operations for large umbilical hernia in fat individuals, are etiologic factors. In some of the reported cases the so-called ileus was probably a rapidly fatal peritonitis, but a sufficient number of authentic cases exist to cause this affection to be considered as a distinct variety of ileus. In other cases toxemia from contaminated or decomposing food appears to be the cause of the condition.

The *symptoms* usually come on in two or three days, although most of the patients seem to do badly almost immediately after operation. The patients are usually extremely nervous women. The symptoms are distention, vomiting which finally becomes fecal, complete constipation, increasing rapidity of pulse, and the signs of collapse. The distention seems to be less marked than is the case in mechanical obstruction, and intestinal peristalsis is wanting. The temperature is usually subnormal. The urine may be scanty and have an increased amount of indican. In fatal cases the patient probably dies of septic intoxication from absorption of the products of the decomposition of the intestinal contents.

The *treatment* has not been definitely formulated. The immediate emptying of the intestinal canal by the formation of an artificial anus offers the best hope of recovery. In the early stages, strychnin, the faradic current, massage, the light application of the cautery to the abdomen, and enemata are recommended. Vogel, Ardt, Craig, and others highly recommend hypodermic injections of eserine. It seems, however, to be of doubtful value according to other observers.

Spastic Ileus (the So-called Dynamic Ileus).—Several cases have been reported since 1897 of a post-operative spasmodic contraction of the bowel giving rise to the symptoms of obstruction. In these cases the condition occurred subsequent to operation upon some of the abdominal or pelvic viscera. In one of them² the patient had practically all of the symptoms of intestinal obstruction, the case was diagnosed as such, and a second operation was performed to relieve the obstruction. At this operation ten inches of the ileum situated just above the ileocecal valve was found tightly contracted and completely occluding the lumen of the gut. Nothing could be found to account for the contraction and

¹ Olshausen: "Ueber eine bisher unerkannte Todesursache nach Laparotomien mit eventration der Darmschlingen." *Ztschr. f. Geburtsh. u. Gynäk.*, Leipz., 1888, xii, 238-241.

² Blume, F.: "Dynamic Ileus Following Operations Involving the Abdominal Cavity, with Remarks on Adynamic Ileus," *Am. Jour. Obst.*, N. Y., 1897, xxxvi, 584-586.

nothing abnormal was noted except slight abrasion of the peritoneal coat in one place. The bowel above the contraction was distended; that below, collapsed and soft. There were no signs of peritonitis or any other lesion to account for the symptoms. An artificial anus was made and the patient died several hours afterward. This is apparently a case of death following operation, due to spasmodic ileus. In another reported case the tightly contracted condition of the gut was found at autopsy and the symptoms were not those of obstruction but of toxemia. In other cases occurring after operation intestinal adhesions existed, and the obstruction may have been due to these, although they were not deemed by the operators to be the cause of the ileus. Kocher¹ says that in most cases of so-called dynamic ileus (meaning both forms) the condition is by no means a pure functional disturbance, but that there are light mechanical hindrances which lie in the background.

The length of the contracted portion of the intestine varied from a few centimeters to that of the entire large intestine. The situation can apparently be in any part of the intestine. In several reported cases of spastic ileus where the primary operation was performed for a supposed intestinal obstruction the contracted gut was seen to dilate while under observation. In one of these cases lead poisoning was considered the cause of the spastic condition of the bowel. A similar condition probably exists in the well-known condition of hysterical tympanites. Murphy² thinks that poisoning by tyrotoxin can cause it, and a case of Werder's tends to show this theory to be correct. Israel reports a case where a comparatively small gall-stone (2 cm. in diameter) caused a spasmodic contraction of the bowel and a complete obstruction.

The condition is a very interesting one, and further observations upon it are desirable.

The *treatment* theoretically would be to employ remedies to relax the spasm, such as atropin, morphin, the hot bath, etc. In some cases it may become necessary to make an artificial anus. An exploratory laparotomy is indicated if other remedies are not effectual, and should be done before the patient becomes very weak. A positive diagnosis can be made only by means of it, and adhesions or other observed causes of the condition may be removed.

ACUTE DILATATION OF THE STOMACH.

A few cases of acute dilatation of the stomach have been observed following operation or the administration of a general anesthetic. Attention has recently been directed toward the condition, and it is probable that many additional cases will be added to the few already reported. Two varieties have been noted: (1) a paralytic condition of the organ, which becomes tremendously dilated, producing a constriction by its weight at the pylorus, and (2) an interesting form, called "gastro-mesenteric ileus," in which there is a compression of the duodenum where it

¹ Kocher: "Ueber Ileus," Mitt. a. d. Grenzgeb. d. Med. u. Chir., Jena, 1898, iv, 195-230.

² Murphy, J. B.: "Ileus," Deutsche Ztschr. f. Chir., Leipz., 1897, xlv, 506-530.

passes beneath the superior mesenteric vessels, causing a dilatation of the stomach and duodenum above the constriction.

The **etiology** of the condition is obscure. The first variety is supposed by some to be a paralytic distention. Adhesions of the omentum to the seat of the pelvic operation, or to the abdominal incision, by dragging the stomach down tend to cause a stenosis at the pylorus or gall-bladder, or a partial stenosis of the pylorus may be produced by adhesions, tampons, drainage-tubes, etc., the subsequent dilatation of the stomach tending to perpetuate the condition. Cases in which there exists at the time of operation an enteroptosis, a chronic dilatation of the stomach, or chronic gastritis seem more prone to the affection.

In the second variety there seems to be a definite constriction of the duodenum at the point where it passes beneath the mesenteric vessels. It is apparently compressed between these vessels and the vertebræ. The cause of this variety is likewise very obscure. The theory is that the small intestines from some cause drag so upon the mesentery that the vessels are made tense and thus constrict the duodenum. A dilated stomach filled with fluid and gas tends to push the intestines downward and in this manner cause the constriction. Hence it would seem that dilatation of the stomach and gastro-mesenteric ileus are very closely related. Dilatation of the stomach can apparently cause constriction by the mesenteric vessels and vice versa. Adhesions of the great omentum causing a dilatation of the stomach, or of the small intestines to the pelvic structures, would tend to produce the constriction. In the majority of the reported cases there have been no adhesions, hence it would seem that the factor most important in the etiology of this condition is dilatation of the stomach.

The **symptoms** of the condition are vomiting large quantities of fluid, eructation of gas, and collapse. The temperature is not elevated, the pulse is rapid, and there is, generally, restlessness and some difficulty in breathing. Examination of the abdomen shows distention in the region of the stomach. There is, as a rule, no visible peristalsis. Once one's attention is directed toward the condition little trouble should be experienced in making a diagnosis unless there is at the same time a distention of the intestines.

The **treatment** consists in emptying the stomach and keeping it empty by means of the stomach-tube, and putting the patient in the elevated hip position to favor the gravitation of the stomach and intestines toward the diaphragm. Dilatation of the vagina and rectum with air while the patient is in the knee-chest or elevated hip position would promote the same results. Rectal alimentation should be resorted to for a few days. After the vomiting subsides gradual stomach-feeding can be resumed. Strychnin, atropin, or eserine would seem to be indicated. The bowels should be emptied by means of enemata alone until the stomach returns to a fairly normal condition.

POST-OPERATIVE COMPLICATIONS INVOLVING THE BRONCHI, LUNGS, ETC.

Among the most frequent and serious complications which arise after operations are inflammatory conditions of the bronchi and lungs. The most important of these are bronchitis, pneumonia, pleurisy, acute edema, gangrene and abscess of the lungs, pulmonary embolus, and the lighting up of chronic tuberculous processes.

The rôle played by the anesthetic in the etiology of these diseases has never been satisfactorily determined. Before the discovery of anesthesia lung complications caused a high mortality after operation, and some recent statistics of v. Mikulicz and other German writers are extremely interesting as bearing upon the rôle played by ether and chloroform in the causation of such complications. Mikulicz¹ states that, at the Breslau clinic in 1005 laparotomies and operations for strumous affections under general anesthesia, there was a pneumonic morbidity of 7.5 per cent, with a mortality of 3.4 per cent. In 273 cases operated upon under local anesthesia (Schleich's method) there was a morbidity of 12.8 per cent. and a mortality of 4.8 per cent. due to pneumonia. This increase, he thinks, was due to the nature of the operation and of the disease from which the patient was suffering, his cases where local anesthesia was employed being from the onset more prone to lung affections than those where ether or chloroform was used. There are other statistics which are equally striking, and they all emphasize the fact that a large proportion of the more serious lung complications after operations are not due to the action of the anesthetic.

I have been unable to find satisfactory statistics as to the relative frequency of the different pulmonary and bronchial complications after operations. In approximately 8000 to 9000 cases of general anesthesia, of which 7000 were operations, in the gynecologic department (Kelly's clinic) of the Johns Hopkins Hospital prior to 1901, there were 17 cases of pneumonia, 18 of bronchitis without other lung affections, 16 of pleurisy, 6 of recognized pulmonary embolism, and one case of gangrene of the lungs. These statistics, while not extremely accurate, are as much so as statistics of the kind can be. It is not possible to always recognize the exact lesion in cases of the kind which recover, and many of those who die do not come to autopsy. In most of these cases the diagnosis was made after consultation with experts in physical diagnosis, and the symptoms, as stated in the notes, have been carefully compared with the diagnosis. Where autopsies took place the anatomic diagnosis was taken. According to the above statistics, pneumonia occurred once in every 523 cases of general anesthesia; pleurisy, once in 566 cases; bronchitis, once in 500; and pulmonary embolism, once in every 1333 cases. Robb and Dittrick in 1007 abdominal operations found that 35 cases developed post-operative inflammatory lesions of the respiratory tract. Of these 35 cases, 18 had bronchitis, 9 pleurisy, 3 acute pulmonary tuberculosis, and 3 bronchopneumonia.

¹ v. Mikulicz, J.: "Pneumonie," Verhand. d. XXX Kongr. der Deutsche Gesellsch. f. Chir., Centralbl. f. Chir., No. 29, 1901, p. 16.

Gerulanos¹ states that in the surgical clinic at Kiel, 7 of 95 deaths occurring after operations were due directly to lung complications. In 1196 laparotomies in the Munich surgical clinic there were 77 cases of post-operative lung affections with 63 deaths.² Bibergeil³ found in 3909 abdominal operations 283 post-operative lung complications.

There are some observations which apply more or less to all of the post-operative lung complications. The immediate effects of the anesthetic, especially ether, upon the mucous membrane of the air-passages are doubtless largely responsible for many cases of bronchitis and edema of the lung. Lindeman (cited by Gerulanos) and Hölscher,⁴ however, could not find in their experiments upon animals that ether produced an inflammatory action upon the lung itself. Chilling or catching cold, either through exposure in a cool operating room or after leaving a heated operating room and returning to a cold ward, is in many cases responsible for pulmonary affections. Hölscher estimates that a patient loses from 0.1° to 3° C. during anesthesia, according to the length of time and the condition of the patient. Weak and feverish patients, according to him, lose more than strong and robust ones. This loss of heat would render the patient liable to pneumonia, bronchitis, etc., unless great care were taken to protect her. The aspiration of mucus, vomitus, and saliva with the bacteria of the mouth and pharynx is responsible for many cases of affections of the lungs, bronchi, etc., which occur after operation. The congestion of the lungs caused by weak circulation, the recumbent posture, and the want of proper expansion of the chest and the aëration of the lungs due to weakness, pain, tight bandaging, and distended intestines, prepare the ground for the infection. The excitement before the operation, the anxiety and unrest, not only cause the patient to take the anesthetic worse than she otherwise would, but by producing a generally depressed condition render her more susceptible to other influences, such as cold. The amount and character of the anesthetic, the skill with which it is given, and the time of anesthesia play important parts. Alcoholic, fat, and plethoric patients require more of the anesthetic and are more apt to suffer with lung complications. Preëxisting pulmonary or bronchial disease plays an important rôle also in the causation of serious lung complications after operation. The nature of the operation likewise seems to play an important rôle in the causation of lung affections, certain operations, as those for strangulated hernia, being more apt to be followed by pneumonia, and those for myomata, etc., by pulmonary embolism. The frequency and importance of the smaller pulmonary emboli which do not cause instant death are underestimated by most observers, many of the post-operative pulmonary affections being of embolic origin. The long continuance in the Tren-

¹ Gerulanos, M.: "Lungencomplicationen nach Operativen Eingriffen," *Deutsche Zeitschr. f. Chir.*, Leipz., 1900, lvii, 361-382.

² Gebele: "Ueber embolische Lungen affektionen nach Bauch-operationen," *Beitr. z. klin. Chir.*, xliii, Hft. 2, 251-318.

³ Cited from *Zentralbl. f. Gyn.*, Nr. 34, 1906.

⁴ Hölscher, R.: "Experimentelle Untersuchungen über die Entstehung der Erkrankungen der Luftwege nach Aether narkose," *Archiv f. klin. Chir.*, lvii, 175.

delenburg position is thought by many to be productive of harm: the abdominal viscera press against the diaphragm and impede its free movements and the gravitation of blood to the most dependent parts would tend to cause pulmonary congestion.

Pneumonia.—The frequency of the occurrence of pneumonia apparently varies in different countries and in different clinics in the same country. This difference may be partly real, but is in greater part only apparent. The difficulty in getting statistics is obvious. It is not always possible to differentiate small bronchopneumonic areas from localized tuberculous processes, hemorrhagic infarcts, etc., and cases come to autopsy with post-operative pneumonia when the condition was not recognized during life. In this country a great many cases who die never come to autopsy, and we have to depend upon a clinical diagnosis. The number of the cases of pneumonia following operation depends also upon the nature of the operation, the methods of operating, the country, the season of the year, the anesthetic employed, and the manner in which it is given. Anders¹ found in 12,842 cases of ether narcosis in Philadelphia 30 cases of pneumonia and 13 deaths. Prescott (cited by Osler), in Boston, in 40,000 similar cases found only 3 cases of acute lobar pneumonia. Henle² in von Mikulicz's clinic in Breslau reports, in 1787 cases of laparotomy and operations for hernia, 143 post-operative pneumonias with 65 deaths, and in 200 amputations of the breast 2 pneumonias and one death. In Gebele's 1196 laparotomies with 77 cases where lung complications followed, 20 of these were regarded as hypostatic pneumonias, 8 as ether pneumonias, 26 as aspiration pneumonias, and in 14 the process was embolic in character. Pietrzkowski (cited by Gebele) reported 13 cases of pneumonia following 210 operations for incarcerated herniæ. Czerny, of Heidelberg, reports 52 cases of pneumonia in 1300 laparotomies. Trendelenburg, of Leipzig, reports that pneumonia follows laparotomies in about 5 per cent. of cases. According to his observations, gastrotomies were complicated by pneumonia in 3 per cent.; operations on the bile-passages, 6.4 per cent.; appendicitis, 5 per cent., and exploratory laparotomies in 4.7 per cent. Mallett³ reports seven cases of "*non-septic pneumonia*" in 1700 laparotomies. In 8000 to 9000 cases of anesthesia, representing 7000 operations in the gynecologic clinic of the Johns Hopkins Hospital, there were 17 cases of pneumonia.

Lobar pneumonia is relatively less frequent than bronchopneumonia. In Henle's cases, of those which came to autopsy 7 were acute lobar pneumonias, 24 lobular or bronchopneumonias, and 17 pulmonary gangrene. In Gerulanos' 7 cases 5 were bronchopneumonias, one gangrene, and one a pulmonary infarct. In 17 cases of Bloodgood's, reported by Osler, 13 were bronchopneumonias and 3 lobar pneumonias. Kummell reports 1070 laparotomies with 8 lobar and 21 bronchopneumonias. In the Johns Hopkins Hospital cases previously referred to, 9 were lobar pneumonias and 8 bronchopneumonias, one of the latter finally resulting in gangrene.

¹ Anders, J. M.: "Ether Pneumonia," Univ. Med. Mag., Phila., 1897-98, x, 641-663.

² Henle: "Ueber Pneumonie und Laparotomie," Archiv f. klin. Chir., xlv, Hft. 2.

³ Mallett, G. H.: Trans. N. Y. Obst. Soc., Am. Jour. Obst., April, 1905, p. 516.

The causes of pneumonia following operation may be divided into the predisposing and the exciting. The predisposing causes are old age; intemperance; weakness or disease of the heart and blood-vessels, and disease of the kidneys; the recumbent posture; the inability to cough up foreign substances, and the imperfect expansion of the lungs on account of pain, distention of the intestines, tight bandaging, coma, and the use of narcotics; edema of the lungs caused by the anesthetic; excitement, shock, etc.; preëxisting disease of the lungs, bronchi, nose, or mouth; chilling of the body during or after operation; and the presence of foreign substances, such as mucus and vomitus. Pulmonary infarcts probably act as the starting-point of a pneumonia in a certain number of cases. Pietrzikowski believed that in 13 cases of post-operative pneumonia the process had its origin in an infarct, while Bebele believes that one-third of the cases of infarct are followed by pneumonia. The *exciting cause* is bacteria which gain access by aspiration of foreign substances and through the blood-channels and lymph-channels. Infected emboli may carry the bacteria or the latter may gain access through the blood-vessels and lymph-vessels without the aid of the former. When the emboli come from the ovarian or branches of the iliac veins the emboli pass through the right heart directly to the lungs, but when from the branches of the portal vein they lodge, as a rule, in the liver, from which point secondary emboli may pass to the lungs. A direct embolus can pass to the lungs from the portal vein only by anastomosis between this vessel and the inferior vena cava. The bacteria which are found to be the cause of post-operative pneumonia are the *Micrococcus lanceolatus*, the pyogenic cocci, the *Bacillus coli communis*, the *Bacillus pneumoniae* of Friedländer, and others.

In our cases age and season of the year did not seem to play important parts in the causation of the disease. The nature of the operation seemed more important, most of the cases having followed serious laparotomies.

Symptoms.—In the cases of *lobar pneumonia* the symptoms, as a rule, appeared a short time after operation, some within twelve hours. The disease usually ran a typical course, beginning with a chill. There was a sudden rise of temperature to 104° or 105° F., rapid pulse, cough with the characteristic sputum, pain in the chest, dyspnea or hurried respirations, and the disease usually ended by crisis. The physical signs were usually unmistakable. The symptoms of *bronchopneumonia* were not so definite. In these cases the symptoms came on later, and it was usually several days before a diagnosis could be made with any degree of certainty. The temperature was not high and was somewhat irregular in its nature, there were generally bronchitis, cough, frequently blood-stained sputum, and rather indefinite physical signs. The cases, as a rule, ended by lysis.

Treatment.—The prophylactic treatment will alone be considered. The three things of most importance are: (1) the careful examination of the patient's chest to detect diseases of the bronchi, lungs, and heart before the administration of the anesthetic; (2) the proper administration of the anesthetic; and (3) guarding the patient against chilling. In most cases it is possible, by proper administration of the anesthetic, to prevent the collection and aspiration of mucus, vomitus, etc.

She should be protected against loss of heat by a properly heated operating room and ward, the protection of the intestine by means of a warm gauze, and having her body well protected, both during operation and afterward. Some surgeons employ operating tables which are heated, and claim by their use to have lessened their mortality. Before 1898 in Mikulicz's clinic the percentage of pneumonias was 8 to 10, which sank to 6.6 in 1899 and 3.6 in 1900, following the introduction of the heated table. Rapidity in operating, proper skill and care in the administration of and the reduction to the smallest possible quantity of the amount of the anesthetic are very important. In cases of strangulated hernia, and when the patient is very weak or has chronic disease of the bronchi and lungs, local anesthesia is indicated; but the more serious operations, especially in nervous, excitable women, should always be performed under general anesthesia. Where the stomach is full it is well to wash it out before operation. Cleansing the mouth, throat, etc., prior to operation is probably of little value. The administration of a small hypodermic injection of morphin and atropin a short time before the operation tends to put the patient in a more quiet frame of mind and to lessen the amount of secretion from the mouth, etc. After operation the patient should be frequently turned in bed, the bandaging should not constrict the abdomen or chest, she should be encouraged to breathe deeply, and to cough up any material which had been taken into the lungs by aspiration.

Pulmonary Embolism.—This affection has been considered under Embolism. In Gebele's 1196 laparotomies, 14 cases of pulmonary embolism occurred. Burkhard in 236 myoma operations saw 12 cases of post-operative pulmonary embolism. Pietrzikowski in 210 cases of incarcerated hernia saw 14 cases of what he considered a hemorrhagic infarct following the operation. According to our statistics, there have been only 6 cases of known pulmonary embolism after 7000 operations. As we will show when considering "pleurisy," the occurrence of small emboli is much more common than is shown by the figures above. Four of our cases died and the other two recovered, although the signs of embolism were quite marked. One case was so typical and shows so plainly the connection between thrombosis, pulmonary embolism, and the so-called post-operative pleurisy that I give it somewhat in detail.

"Mrs. C—. Operation: Hysteromyomectomy (May 11, 1895). No complication—easy operation.

"*May 18th.*—Sudden attack of sharp pain over a localized area in the left chest. This was increased by deep inspiration. Temp. 103° F., pulse 104, dry cough. Physical examination showed a pleuritic friction sound in region of pain, the other signs being indefinite.

"The pain decreased and the signs of pleurisy had disappeared by May 24th.

"*May 29th.*—While using a bed-pan she was suddenly seized with a fainting spell and complained of a feeling of oppression over the sternum. The physical examination of the chest was negative. Pulse 120, feeble. Her symptoms increased, and in a few hours she was suffering from dyspnea, a heavy aching pain over the sternum, ringing in the ears and dark spots before the eyes, cold and clammy

extremities. The pulse was 140 and the heart's action tumultuous. (Under a mistaken diagnosis of hemorrhage, an exploratory laparotomy was performed, but nothing was found to account for the symptoms.)

"May 30th.—Patient better. Pain in chest continues. Pulse 120. Pain is complained of in the left leg.

"May 31st.—Well-marked symptoms of phlebitis in left leg.

"June 7th.—Phlebitis in right leg."

The patient eventually recovered. In this case there was probably a thrombus in one of the pelvic veins which extended to the iliac and finally caused the so-called phlebitis. The attack of supposed pleurisy was undoubtedly an infarct from a small embolus and the second attack a typical one of pulmonary embolus, which probably partially plugged a larger vessel.

In one of the fatal cases the symptoms grew less marked after a few hours. Examination of the chest showed stridulous breathing and tumultuous heart action, but was otherwise negative. She died at the end of twelve hours. Cases have been reported where the patient lived several days after the occurrence of the embolism, and a small percentage end in recovery.

Pleurisy.—Acute pleurisy occurring after operation and independent of pneumonia and tuberculosis is less frequent than would appear at first sight. Most cases where there is severe pain in the chest accompanied with a pleuritic friction rub and without definite signs of pneumonia are diagnosed as pleurisy. In the majority of these cases the pleurisy is secondary to some other process, as hemorrhagic infarct or a small spot of bronchopneumonia. The relation which exists between pleurisy and embolism is strikingly illustrated in our cases. In the 16 cases of so-called pleurisy which have been previously mentioned, in only one was there an effusion, and in more than one-half of them there were either evidences of a thrombus or signs of an embolus. The case cited under Pulmonary Embolism illustrates very forcibly the relationship existing between the two affections. The following are some of the cases of pleurisy which show the same relationship:

Case 2: Phlebitis followed in seven days by pleurisy

Case 3: Signs of pleurisy with a phlebitis on the following day.

Case 4: Phlebitis followed in one month by pleurisy (localized).

Case 5: Pleurisy on the tenth day. Edema of legs on sixteenth and seventeenth day respectively.

Case 6: Phlebitis on twenty-third day and pleurisy on twenth-eighth day after operation.

Case 7: Pleurisy with signs of pulmonary embolism, *i. e.*, sudden dyspnea, cyanosis, rapid pulse, cold extremities.

Case 8: Pleurisy (?) developed eleven days after operation. This gradually cleared up, and on the twenty-seventh day as she was leaving hospital she fell over and expired. No autopsy allowed, but the diagnosis was "pulmonary embolus."

A certain number of cases of pleurisy are tuberculous in origin, but the proportion of such cases after operation is smaller than that seen in general medical wards. Cases of pleurisy arise, also, which are not due to pneumonic areas in the

lung, but owing to the fact that nearly all recover it is difficult to estimate the correct proportion of the different varieties. A certain number of cases of pleurisy are due to an extension of an infection through the diaphragm. These forms of pleurisy occur most frequently in cases of subphrenic and liver abscess.

The symptoms and treatment will not be dwelt on here. In a few cases arising in our wards the diagnosis wavered between diaphragmatic pleurisy and gall-stones.

Gangrene of the lungs is a rare post-operative complication of gynecologic operations, and is generally the result of aspiration of vomited material during anesthesia. It may occur from the same cause in very weak or unconscious patients. At times it results from emboli which arise from gangrenous wounds or from the infection of an infarct with the putrefactive bacteria. The symptoms vary considerably and will not be gone into here. The diagnosis is largely based upon the character of the expectoration, which is intensely fetid and usually of a greenish color. The German writers apparently meet with it more often than is the case in America. From the statistics given before, it seems not an unusual complication in some of their clinics, while only one known case was seen following 7000 operations in the gynecologic wards of the Johns Hopkins Hospital.

Abscesses of the lungs are even less common than gangrene except as an accompaniment of pyemia or an extension from some neighboring organ. The causes are the same as gangrene, with the absence of the putrefactive bacteria. Hence it is most often found in cases of pyemia and not as the result of an aspiration pneumonia.

Edema of the lungs to a greater or less extent occurs in all forms of intense congestion and inflammation. General edema occurring after operation is stated to have for its causes the direct action of the anesthetic upon the lung and a depression or paralysis of the vasomotor center. Disease of the heart and kidneys is a predisposing cause. The intravenous use of salt solution in large amounts is conducive to the affection. Noble says that, since using salt solution freely, and especially since elevating the foot of the bed with the peritoneal cavity full of this solution, he has had six cases of pulmonary edema. While he does not assert that the edema is due to the posture and use of the saline, he thinks the frequent occurrence of edema very suggestive. Overfilling the blood-vessels, diluting the blood, and giving the patient a posture which tends to compress the lungs and embarrass the heart would, theoretically, tend to cause an edematous condition of the lungs. The principal symptoms are dyspnea and cough. The physical signs are indefinite, there being usually defective resonance and large liquid rales over the bases. In acute cases active purgation and venesection are indicated. Cardiac stimulants should be freely used.

Pulmonary tuberculosis as a post-operative affection is not well worked up. The conditions of the lungs which favor its development are generally present after a serious operation. Doubtless many cases have had surgical operations as their starting-point, but it would appear that in more, the acute tuberculous process is a lighting up of a preëxisting lesion. The encapsulated or quiescent tuberculous

nodule becomes the starting-point of a more serious lesion. I have seen two cases of acute pulmonary tuberculosis following simple hernia operations. They both came to autopsy within six weeks after operation.

It is often necessary to operate upon patients that are known to have chronic pulmonary tuberculosis. In these cases local anesthesia should always, where possible, be employed, and when necessary to use chloroform or ether the former is to be chosen.

Acute Bronchitis.—This is one of the most frequent affections of the air-passages which follow anesthesia. It generally accompanies pneumonia, but appears also quite frequently as an independent affection. There were eighteen cases among our patients which were quite independent of any signs of pneumonia, etc.

The *causes* are the immediate effects of the anesthetic, especially ether; the existence of chronic bronchitis; catching cold during or after operation; and the aspiration of mucus and vomitus during narcosis.

The *symptoms* and *treatment* are those of ordinary bronchitis. The prophylaxis is most important, special attention being given to prevent chilling of the body in a cold operating room or having the patient not sufficiently protected in moving her from the operating room to the ward. The coughing, frequently severe, causes pain in those patients who have an abdominal incision, and the remedies which check the cough are contraindicated to a certain extent, as the accumulation of the irritating substances is a frequent cause of bronchopneumonia. The violent coughing has in a few cases caused a separation of the edges of the incision.

POST-OPERATIVE COMPLICATIONS CONNECTED WITH THE BLADDER, KIDNEYS, ETC.

Numerous complications connected with the urinary tract may arise after gynecologic operations, the chief of these being retention and incontinence of urine, cystitis, suppression of urine, nephritis, hemorrhage into the kidney or bladder, fistulas (renal, ureteral, or vesical), pyonephrosis and hydronephrosis.

Retention of Urine.—The inability to void the urine occurs quite frequently after operation. The necessity for catheterization a few times after operation arises in at least one-half of the cases of laparotomy, and with some patients the catheter has to be used for weeks. The dorsal posture is to a large extent responsible for this inability to empty the bladder. The pain which is caused by the muscular effort in straining frequently prevents the patient from voiding, while a urethritis or an operation which involves the urethra or bladder is, at times, the cause of the retention. Hysteria and nervousness are likewise factors. Vaginal packs, clamps, etc., which compress the urethra may make it impossible to pass the urine until they are removed. Occasionally a condition exists in which the patient voids her urine but the bladder is not emptied by the act. In such a case the residual urine is liable to undergo decomposition, cause a cystitis, or even produce a hydrone-

phrosis or pyelitis. This dilatation of the bladder is indicated by a frequent desire to urinate, discomfort in the region of the bladder, and the presence of a tumor just above the symphysis. The passage of a catheter will clear up any doubt which may exist as to the diagnosis.

Treatment.—As the cause of cystitis in a large percentage of all cases can be traced to the use of the catheter, it is evident that catheterization should, if possible, be avoided. In minor operations, such as dilatation and curetage, it is well in most cases to allow the patient to sit up in bed, in which position she can usually pass her urine. In cases away from hospitals, and where the services of a doctor or competent nurse cannot be had when wanted, the management of this affection becomes quite a problem. After perineorrhaphy and other operations where there is little likelihood of secondary hemorrhage or embolus, it is advisable, at times, to have the patient lifted to a knee-elbow position, when she can usually pass her urine without difficulty. In all cases the patient should be encouraged to void by having the bed-pan placed under her and allowing a stream of warm water to play over the external genitalia. In those where there is no abdominal incision she should aid herself by making pressure over the bladder above the symphysis. In case it is necessary to use the catheter the most rigorous precautions should be enforced to prevent carrying in bacteria, and injuring the urethral or bladder mucosa. Nevertheless cystitis will arise under favorable conditions in spite of the most rigid care on the part of the nurse.

Incontinence of urine may occur after operation and is, at times, a sign of an overdistended bladder. As a rule, the constant passage of the urine indicates that an opening has been made in the bladder or that one or both ureters have been injured. This accident not infrequently happens after pan-hysterectomy and other operations upon the pelvic organs in which the vagina has been opened. Another occasional cause of incontinence is over-dilatation of the urethra. The female urethra measures on an average 7.59 mm. in diameter,¹ and while it is, in most cases, possible to dilate it to admit without injury a speculum or sound 10 mm. in diameter, if the dilatation is carried much beyond this point the sphincter of the urethra is so stretched that it frequently loses its power of contraction for some days and incontinence ensues. The dilatation of the urethra to admit the finger is justifiable only in extreme cases. Severe cystitis, new-growths, and undue pressure on the bladder from exudates, etc., are also causes of incontinence.

Treatment.—There are two indications for treatment: viz., (1) to remove the cause, and (2) to prevent excoriation of the genitalia and infection of the bladder by means of scrupulous cleanliness, boric washes, the application of zinc ointment, or, more useful than all, the continuous bath. Many patients remain in the bath day and night without discomfort, while others do better if allowed to remain out at night.

Post-operative Cystitis.—The general consideration of cystitis is found in

¹ Miller, G. Brown: "Measurement of the External Urethral Orifice," Johns Hopkins Hosp. Bull., Aug., 1901, 251-252.

another chapter in this book, but the affection occurs so frequently as a post-operative complication that a brief notice of it here will not be out of place. It is one of the most distressing as well as one of the most frequent of the complications which follow gynecologic operations. Cases which resist treatment for months and years occur after the simplest operations, such as perineorrhaphy, suspension of the uterus, etc.

Causes.—Cystitis can follow the internal administration of certain drugs, as cantharides. Cases occasionally occur as the result of irritating chemical solutions used as bladder irrigations. Foreign bodies when left in the bladder may cause a mechanical inflammation. The disease is caused in nearly all cases by the action of bacteria. These are generally introduced in the act of catheterization, but may invade the bladder also from neighboring abscesses, from inflammatory exudates, through fistulas (suprapubic, vesicovaginal, rectovesical, etc.), or from an infected kidney or ureter. The microorganisms, at times, gain entrance through the blood-vessels or lymph-vessels, by direct invasion from the intestinal tract, or through the urethra. In certain cases the mere introduction of bacteria seems to be all that is necessary to cause the cystitis. Nearly all investigators, however, are agreed that there are certain conditions which predispose to infection of the bladder. In the normal bladder bacteria can be introduced and may not cause a cystitis, while if the predisposing conditions are present the affection is apt to result. Anything which prevents the complete emptying of the bladder—as exudates in the adjacent tissues, pelvic tumors, cystocele, fixation of the uterus in malpositions, or partial paralysis of the bladder by injury or overdistention—renders this organ more liable to infection. There seems to be a special liability to cystitis following pan-hysterectomies for carcinoma of the cervix and after operations where much trauma of the bladder occurs. The other predisposing causes are congestion of the bladder, a wide, patulous urethra, abrasion of the wall of the bladder or urethra, and the presence of foreign bodies.

The bacteria which are most frequently found in post-operative cystitis are the *Bacillus coli communis*, the various staphylococci, the *Bacillus proteus vulgaris*, and the *Streptococcus pyogenes*.

The *symptoms and diagnosis* of cystitis will not be given here further than to state that the condition is usually not recognized until the occurrence of vesical pain and tenesmus. The frequent examination of the urine for a few weeks after operation is advisable in all cases, as by this means the condition can be recognized in its incipency. Any unexpected elevation of temperature occurring after the first five or six days following operation should make one consider cystitis as a possible cause.

With regard to *prophylaxis* it is well to emphasize the necessity of avoiding injury to the bladder during operation, of the careful arrangement of tampons and drains, and the utmost care in the use of specula, catheters, and sounds in exploring the bladder when the patient is anesthetized. If the use of a retention catheter be necessary, great care should be exercised in preventing infection in changing it,

and in the selection of one which will cause no abrasion of the mucosa of the bladder or urethra. It is necessary to see that it drains well and that no urine returns from the receptacle, which should contain an antiseptic solution, into the bladder.

The most frequent cause of cystitis is catheterization. This procedure not only introduces bacteria, but frequently produces an abrasion of the mucosa of the bladder or urethra. The following suggestions have been found of value in catheterization after operation: Allow the patient to go eight to ten hours before the catheter is used, unless she suffers considerable pain; encourage her to void by placing a bed-pan under her and allowing a stream of water to flow over her genitalia; use a stream of some weak antiseptic solution in cleansing the meatus instead of cotton pledgets; use the smallest glass or soft-rubber catheter feasible and do not handle the portion of the catheter which is to be inserted into the urethra. Following the advice of Wertheim, several operators after the abdominal hysterectomy for cancer of the uterus, or after any operation where the bladder is injured, practise irrigation of the bladder at each catheterization until it can be completely emptied voluntarily.

The use of the normal salt solution subcutaneously or into the peritoneal cavity, by diluting the urine tends to act, no doubt, as a prophylactic measure against the occurrence of cystitis.

The *treatment* of cystitis is given fully in another chapter of this work, but I will detail here the method which has given the most satisfactory results in my hands. As soon as the diagnosis of cystitis is made the patient is put upon a bland diet, urotropin (gr. xx) is given daily, and the bladder is irrigated with a 2 per cent. boric acid solution twice daily. Following the thorough irrigation, 2 to 4 ounces of 0.5 per cent. protargol solution is allowed to run into the bladder and to remain fifteen to twenty minutes, the patient voiding it at the end of this time. This instillation of protargol has given me really remarkable results in the cases where I have employed it in post-operative cystitis. In most of the cases pus and bacteria have disappeared after a few instillations and the patients were practically well in two or three days. The urotropin is continued for a week or ten days longer and the urine is examined daily. If there is a return of the cystitis, the irrigations and instillations are repeated.

Kidney Complications.—During the administration of ether there is a diminution in the amount of the urine which is secreted and albumin generally makes its appearance. Thomson and Kemp¹ found in experiments on animals that there was in dogs a constant decrease in the amount of the secretion, and under free and continuous etherization a complete suppression of urine occurred. Albumin appeared early even under moderate anesthesia, and increased in amount until, just before suppression occurred, it amounted to 60 per cent. by volume. Chloroform had much less influence upon the urinary secretion, the urine continuing to flow until just before death and albumin appearing only after prolonged anesthesia. Kelly²

¹ Thomson (W. H.) and Kemp (R. C.): "Experimental Researches on the Effects of Different Anesthetics," *Med. Rec.*, N. Y., 1898, liv, 325-330.

² Kelly, H. A.: "Urinalysis in Gynecology," *Am. Jour. Obst.*, N. Y., 1893, xxviii, 429.

and Noble¹ called attention to the necessity for systematic examination of urine prior to operation and the danger of operating upon cases where chronic nephritis exists. According to Kelly, Noble, Russell,² Ogden,³ and others, in a large percentage of cases albumin and casts make their appearance in the urine after operations. Their presence is not, as a rule, significant, and is due probably to circulatory changes in the kidneys, for in a few days they disappear entirely. Sugar is exceptionally found after anesthesia, and is likewise of little significance. The quantity of urine is markedly diminished during the first few days after operation, the amount being usually only 500 to 600 c.c. With the free ingestion of water the amount of urine is greatly increased. Enteroclysis, hypodermoclysis (after operation), and the giving of water freely before operation, greatly increase the amount of urine after operation.

Acute nephritis following gynecologic operations is an extremely rare affection, except in cases of post-operative pneumonia, infections, and ileus. Independently of these diseases it is seldom seen. In 7000 gynecologic operations at the Johns Hopkins Hospital I could find only two such cases where the symptoms of nephritis were marked. Its causes are cold, the use of turpentine or carbolic acid, infections, and to a certain extent, perhaps, the action of the anesthetic. Acute nephritis frequently accompanies intestinal obstruction, and is, at times, hemorrhagic in character. Noble disagrees with this statement and considers post-operative nephritis as indicated by the presence of casts and albumin in the urine, with diminished secretion, as being quite common, and easily curable, as a rule.

The *symptoms* vary considerably and the diagnosis can in many cases be obscure. In one of our cases there was no edema. The nephritis followed a suspension of the uterus and perineorrhaphy and the symptoms were as follows: Temperature of 102° to 103° F., convulsions, headache, defective eyesight, anemia, and nausea. The urine contained a large amount of albumin and a large number of hyaline and granular casts. She eventually recovered. In the other case the nephritis was accompanied by mania. Although acute nephritis arising in previously healthy kidneys rarely occurs *after* gynecologic operations, chronic nephritis frequently exists at the time of operation and has a marked influence upon the extent of operative procedure, the prognosis, and the after-treatment.

Suppression of Urine.—As has been previously noted, for the first few days after operation there is a marked diminution in the amount of urine secreted. This is due to the recumbent position, the diminished ingestion of fluids, the loss of blood, perhaps the action of the anesthetic, fever, and congestion of the kidney. In some cases, however, the amounts of urine and urea remain so small that we look for some cause of the diminution or suppression.

The *chief causes of urinary suppression* are as follows: Nephritis; blocking

¹ Noble, C. P.: "The Relation of Certain Urinary Conditions to Gynecological Surgery," *Am. Jour. Obst.*, N. Y., 1893, xxviii, 753-762.

² Russell, W. W.: "Urinalysis in Gynecology," *Johns Hopkins Hosp. Rep.*, iii, 433.

³ Ogden, J. B.: "Effects of Ether on the Kidneys," *Jour. Bost. Soc. Med. Sc.*, 1897, No. 15, 18-23.

of one ureter, or serious injury to one kidney with coexisting disease of the other; the ligation or clamping of one or both ureters; removal of the only kidney; obstruction of the bowels; and collapse after severe operations.

In our 7000 cases the ureter is known to have been accidentally ligated or clamped fifteen times. In twelve of these cases the ligation or clamping was discovered before the patient left the operating table and the error remedied. In one case of vaginal hysterectomy for carcinoma of the cervix, the ureter containing a bougie was clamped and the bougie broken off, a portion of it being left in the ureter. The condition of the patient prevented any operative procedure for its removal. Her death on the seventh day after operation was probably due in part to the accident. In another case where the catheterized ureter was clamped and the clamp removed the ureter was so injured that a ureterovaginal fistula resulted, but healed in a few weeks without operative procedure. In the remaining ten cases no untoward results are known to have arisen, although in one instance the ureter was twice ligated and once clamped. Of the three cases in which the accident was not discovered, two died and one developed a ureterovaginal fistula. In another case almost total suppression of urine occurred after the removal of a large calculus from one kidney when the other was almost totally destroyed by a second stone. The largest number of cases of urinary suppression probably occurs in patients where one kidney is removed when the other kidney is likewise diseased. The greatest care should always be exercised to ascertain the exact condition of both kidneys before the removal of either. This can be done only by the examination of the separated urines; palpation and inspection of the kidney being valuable aids. Without the urinary examination the latter are not to be depended upon. The necessity of repeated and careful urinary examinations is to be emphasized in operations for incarcerated fibromyomata or other conditions where the kidneys are apt to be affected from pressure upon the ureters. In one of my cases where after a difficult hysteromyomectomy the patient died from urinary suppression, there was found at autopsy one atrophied kidney and an acute nephritis in the remaining organ. Two cases of complete suppression due to obstruction in the small intestine have come under my observation. Suppression of urine in previously healthy kidneys as a direct result of the anesthetic or collapse is rare as a post-operative complication.

The *diagnosis of the cause* of the suppression is very important, especially if there is a possibility of occlusion of the ureter. The diagnosis of occlusion of the ureter is usually very difficult to make, there undoubtedly being women in whom one ureter is occluded at operation and no symptoms arise during the convalescence to indicate its occurrence, or in whom the symptoms are confounded with those which so frequently follow serious laparotomies. The important points in making a diagnosis of the condition are: (a) pain along the course of the ureter and in the region of the kidney, (b) the nature of the operation and the probability of the occurrence of the accident, and (c) complete suppression of urine or marked diminution in the amount passed. The last sign is of little importance unless found in combination with at least one of the others. In cases where there is a strong prob-

ability of the accident having occurred the ureters should be catheterized if the condition of the patient warrants such a procedure.

The *treatment* depends largely upon the cause. When the ureter is obstructed the obstruction should be removed just as soon as a diagnosis can be made. In ileus, operative procedure for its relief is usually too late after suppression occurs, although it should be tried. In all cases where there is no obstruction of the ureter the treatment consists in cupping the loins, hot applications, free purging, and sweating with the vapor bath or with pilocarpin. It should not be forgotten that pilocarpin is a treacherous drug and likely to cause edema of the lungs. Diuretin is recommended after the secretion has started. Irrigation of the rectum with hot salt solution by means of a two-way tube is likewise recommended. The method of Murphy of permitting salt solution to run into the rectum drop by drop, averaging a quart every two or three hours, is to be commended highly. Enemata and subcutaneous injections of salt solution are very useful. The treatment of nephritis as a post-operative affection differs only from that usually laid down in so far as it is modified by the wound and other conditions pertaining to the operation.

Blood-clots.—Occasionally after operations upon the kidney or bladder free hemorrhage occurs and the blood clotting in the bladder acts as a foreign body. An almost complete cast of the bladder may be produced by the blood-clot. Unless these clots are removed they will give rise to pain and discomfort, or, becoming infected, may cause cystitis or an ascending infection of the kidneys. The condition may be diagnosed by the continued presence of blood in the urine, frequent and painful micturition, and by palpation. By means of the latter the clot of large size can generally be detected.

The *treatment* consists primarily in checking the hemorrhage, and secondarily in removing the clots. If the hemorrhage comes from a vessel in the bladder wall after the closure of a fistula it is better to cut the sutures, find the vessel, ligate it, and resuture. Where the hemorrhage comes from the kidney and the blood coagulates in the bladder, it generally suffices for its removal to irrigate the bladder frequently with the normal saline solution until all of the clots have been dissolved. It may be necessary to open the bladder through the vagina to turn out the clots, but this, as a rule, is unnecessary.

Pyelitis—Pyonephrosis.—Inflammation of the pelvis of the kidney and the conditions which result from it may follow operation and be due to various causes. It is, however, most frequently seen, when occurring as a post-operative complication, in those cases in which the kidney, ureter, or bladder has been operated upon, accidentally injured, or is involved in inflammatory exudates, or as consecutive to cystitis. Cases of implantation of the ureters into the intestine are almost invariably followed by an ascending infection of the kidney. Ureteral fistulas emptying into the vagina or on the skin are apt sooner or later to lead to a pyelitis. In like manner there is considerable danger of the infection extending from a cystitis to the kidney along the ureter. Pyelitis following cystitis is usually bilateral. In cases of infection of the kidney pelvis the process is liable to extend by way of the tubules or

lymphatics to the kidney substance, causing acute suppurative nephritis. The latter condition may arise in the manner just indicated or it may be a part of an infection coming from other portions of the body through the blood-channels or lymph-channels. After operation upon the pelvic organs many conditions favorable to the development of a pyelitis may be present; namely, there may be pressure upon the ureter by exudates, ligatures, packs, or scar tissue in the bladder or along the course of the ureter, causing a blocking of the ureter and a dilatation of the ureter and pelvis of the kidney; there may be suppuration in the immediate vicinity of the ureter; the vitality of the patient is lowered by the primary disease and the operation through which she has been, and cystitis is not infrequently present to act as a starting-point for the infection. The infection at times reaches the kidney through the blood, and not as an ascending ureteritis.

The *symptoms* are as follows: (1) *Pyuria*. The urine contains pus and bacteria. When only one kidney is involved, the amount of pus in the urine may vary, due to the temporary blocking of the ureter on the affected side. The bladder is usually involved and consequently there may be painful and frequent micturition. (2) *Fever* of an intermittent type associated with chills is usually present. (3) *Pain* in the region of the kidney may be present and occasionally an attack resembling renal colic is seen. (4) The general condition of the patient indicates suppuration and, at times, loss of kidney function. (5) Physical examination may reveal tenderness over the kidney and, at times, an enlargement of the organ. (6) Examination of the bladder and observation of the urine as it comes from the ureter, or its collection by means of the ureteral catheter, is quite feasible in most cases, and is of the greatest value in the determination of the diagnosis, prognosis, and treatment.

The *diagnosis* is of the utmost importance, as it may save the patient from useless operative procedure, dosing for malaria, etc., and indicate at least some rational method of treatment. It is likewise very important to know if one or both kidneys are infected and the working value of each. This can be done by the use of the ureteral catheter in collecting the urine from the infected kidney, and in examining this urine and that from the bladder with regard to specific gravity, amount of pus, color, reaction, and amount of urea. I will illustrate by an example: The specimen obtained from the ureter from which purulent urine was seen to flow is found to have a low specific gravity, considerable amount of albumin, much pus, and very little urea. The bladder urine has a higher specific gravity, less pus and albumin, and more urea. Now the inevitable conclusion must be that the other kidney is doing more work than the infected one. If, in addition to this, some urine can be collected from the supposedly healthy kidney without running any risk of infecting it, and this proves to be normal, the feasibility of removing or draining the infected kidney can be considered. The subject of kidney infection is treated more fully in diseases of the urinary tract, but the necessity of recognizing the disease as a complication of operation is so important that a notice of it here was not considered out of place.

Hydronephrosis or dilatation of the pelvis and calyces of the kidney by the accu-

mulation of non-purulent urine, may likewise occur as a post-operative complication. *Hydro-ureter* usually accompanies the post-operative variety of hydronephrosis.

The *causes* of post-operative hydronephrosis are conditions arising during or after operation which cause blocking of the ureter. This blocking is usually not complete, as, when no urine passes along the ureter, atrophy of the kidney is said to result. The interference with the lumen of the ureter may be due to ligation or injury of the ureter; fixing the kidney in malposition; or twisting, kinking, or compression of the ureter at the time of the operation. After operation adhesions, exudates, scar tissue, tampons, and over-distention of the bladder may act as causes of hydronephrosis. In many cases there is at first a hydronephrosis, which later becomes infected, forming a pyonephrosis.

The *symptoms* of the affection are usually as follows: (1) Pain in the region of the kidney and along the course of the ureter. (2) Diminution for a short but varying period of time of the amount of the urine passed. (3) The presence of a tumor in the region of the kidney, which is usually tender. (4) Uremic symptoms may be present.

The catheterization of the ureters will show whether or not the ureter is blocked.

The indications for *treatment* are to remove, if possible, the cause of the constriction of the ureter, and to supplement the work of the kidney by purgation, diaphoresis, etc. In a number of cases of post-operative hydronephrosis and pyonephrosis, nephrotomy or nephrectomy is indicated.

Fistulas.—Fistulas following operations upon the urinary tract are of tolerably frequent occurrence and can be conveniently divided into renal and circumrenal, ureteral, and vesical.

Renal and Circumrenal Fistulas.—Following nephrectomy, nephrotomy, nephropexy, and other operations upon the kidney, a fistula may form. This may not communicate with the pelvis of the kidney nor with the urinary tract at any point, and in this case no urine escapes from the fistulous opening. Should the fistula lead down to the pelvis of the kidney or ureter, urine will usually be found to escape along the tract. Nephrotomy for hydronephrosis, calculus, suppurative nephritis, or tuberculosis of the kidney is liable to be followed by a fistula which frequently does not heal until the kidney is removed.

Morris¹ gives the following table to illustrate the frequency with which fistula follows operations on the kidney:

Nephrolithotomy.....	33 operations.	Fistula in 5 cases.
Nephrotomy for calculus.....	32 "	Fistula in 10 "
Nephrectomy for calculus.....	12 "	Fistula in 2 "
Nephrectomy for acute suppuration.....	1 operation.	Fistula in 0 "
Exploration of kidney.....	42 operations.	Fistula in 1 case.
Operations for nephropexy.....	57 "	Fistula in 7 cases.
Operations for hydronephrosis and pyonephrosis.....	16 "	Fistula in 2 "
Operations upon tuberculous kidneys.....	21 "	Fistula in 3 "
Operations upon tumors of kidneys.....	11 "	Fistula in 0 "
Operations for injury of kidneys.....	4 "	Fistula in 2 "
	229	32

¹ Morris, H.: "Surgical Diseases of the Kidney and Ureter," 1901, i, 378.

Where a suppurative process is going on in the kidney; where there is tuberculosis, either renal or circumrenal; where there is an obstruction to the passage of the urine along the ureter; or where foreign bodies, such as a calculus or a non-absorbable suture, are present, the tendency for the fistula to remain open is much greater than in other cases. In Morris' cases the majority finally closed.

These fistulas nearly all open externally and very little difficulty is experienced in determining their nature. Rarely in nephrectomy is an opening made into the duodenum or colon, and a fistulous tract leading into the gut may persist. A case occurred in the gynecologic service of the Johns Hopkins Hospital in which two fistulas communicating with the duodenum followed the removal of a densely adherent kidney. Renal fistula communicating with the stomach or portions of the alimentary tract other than the duodenum or colon, or opening into the lung, have been reported, but these were not post-operative in character.

Treatment.—After the formation of the fistula it should be kept clean by irrigations and frequent changing of the dressings. Injections of stimulating solutions, cauterization, etc., may be tried after the fistula has become chronic. If it shows no tendency to heal after several months, an operation, thoroughly exploring the fistulous tract, should be done, and foreign bodies, as sutures and calculi, removed. In case the kidney is tuberculous or badly diseased and the other one is healthy, a nephrectomy is advisable. If the persistence of the fistula is due to the blocking of the ureter by a calculus or stricture or other cause, this should be remedied by the operative procedure, and where tuberculosis of the ureter is the cause of the persistence of the fistula ureterectomy is advisable.

Ureteral Fistulas.—Post-operative ureteral fistulas are generally due to traumatism of the ureter during operation, or to sloughing of this structure produced by interference with its blood-supply in the extensive dissections now practised in operations for carcinoma of the cervix, or by pressure of clamps, drainage-tubes, ligatures, etc. The point where the injury to the ureter occurs being in by far the greatest number of cases in the pelvis, we commonly see ureterovaginal fistulas. The fistula may, however, open into the abdominal wound, into the bladder, or into the intestine. In case no provision is made for the escape into the urine externally at the time of operation, it finds its way into the peritoneal cavity or infiltrates the tissues of the pelvis or abdominal walls.

Where the urine escapes through the vagina or along the drainage tract in the abdominal wound the diagnosis of urinary fistula is self-evident. The differential diagnosis between ureteral and vesical fistula is given in the chapter devoted to this subject.

The occurrence of a ureteral fistula where there is free escape of urine does not, as a rule, interfere to a marked extent with the recovery of the patient from the primary operation. Death is the usual result when there is infiltration of the tissue with urine or an escape of it into the general peritoneal cavity.

The indication for *immediate treatment* is to provide for a free escape of the urine,

approximated muscles and fasciæ the contiguous parts can be readily separated. It occasionally occurs where silver wire is employed, three cases of the kind being known to me. When the through-and-through silkworm-gut or silk sutures are used the accident is less liable to take place. In one case three through-and-through silkworm-gut sutures were broken by straining effort on the fourth day and eventration resulted. Catgut sutures are liable to become untied and thus allow an early separation of the sides of the wound. In the cases where silver wire was used the sutures became untwisted.

Jahreiss¹ reports a case of separation of the sides of the laparotomy wound which occurred upon the ninth day after operation and six hours after the removal of the interrupted silk sutures. There was no suppuration of the wound. The patient was badly nourished, had icterus, and could take little nourishment. Jahreiss thought trophic disturbances the cause of the separation of the incision. He quotes a case of Mittermaier in which the wound probably burst open upon the third day after operation. It was discovered ten days after the accident. In this case catgut sutures alone were used.

Brettauer² reports three cases. In one case buried silk sutures were used to close the muscles and fascia and catgut to approximate the peritoneum and skin. The condition was discovered seven days after operation. In another case buried silkworm-gut sutures were used throughout and the wound was found open six days after operation. This patient died. In the cases coming under my own observation in the majority the accident happened within forty-eight hours after operation. Madelung thinks that the critical days are the eighth and ninth after operation.

Syphilis, cachexia, diabetes, and other constitutional conditions are considered as predisposing causes in the cases where the accident occurs late.

Its occurrence is accompanied by pain and symptoms of shock, and attention is usually directed to it by the staining of the dressings after a fit of coughing or vomiting. The coils of the intestines may protrude only slightly into the gaping wound or may be forced entirely outside of the wound and lie just beneath the dressings on the abdominal wall. If the accident is not immediately discovered and remedied, adhesions form and the symptoms of intestinal obstruction are apt to arise. If suppuration has taken place in the incision, a fatal general peritonitis is almost certain to follow the occurrence of the separation. Fortunately in cases of suppuration deep in the wound, adhesions form between the intestines or omentum and the abdominal wall, and in a large majority of such cases prevent a wide separation of the incision, the protrusion of the gut, or a general peritonitis.

The *treatment* of the cases where there is no suppuration is to freshen the edges of the wound and to resuture it after replacing the protruding viscera. If the wound is infected and adhesions have shut off the general peritoneal cavity, the

¹ Jahreiss: "Ein Fall von Platzen der Bauchwände nach Laparotomie," *Centralbl. f. Gynäk.*, Leipz., 1896, xx, 944-946.

² Brettauer, J.: "Three Cases of Rupture of the Abdominal Wound after Celiotomy," *Am. Gynec. and Obst. Jour.*, N. Y., 1899, xiv, 324-332.

treatment is to pack with gauze and partially approximate the edges of the incision with adhesive straps, allowing the wound to heal by granulation. If intestinal obstruction occurs the condition is dealt with according to the principles given under that heading. It is inadvisable in the presence of pus to reopen the peritoneal cavity in the immediate vicinity of the wound. In such cases an artificial anus can be made, and after the incision has healed the obstruction can be dealt with by a second operation. In clean cases the adhesions should be separated when the wound is closed.

SLOUGHING OF THE ABDOMINAL WALL.

In a case coming under my observation it became necessary to reopen the abdomen a few days after a laparotomy which had been performed for pelvic inflammation. The cause of the second operation was an intestinal obstruction. The abdominal walls were extremely thick and fat. On account of signs of suppuration in the first incision it was deemed advisable to make the second 3 or 4 inches to one side of it. The whole of the skin and fat between the two incisions sloughed and the large raw area thus formed healed by granulation. The cause of the sloughing was undoubtedly due to the cutting off of the blood-supply of the tissue which sloughed, by the incisions. Sufficient time had not elapsed after the first operation to enable the blood-vessels to form across the line of the first incision and supply the tissue between the two. The very fat walls were a predisposing factor.

This complication is liable to occur in similar cases, although I have not been able to find a case reported in the journals. If it becomes necessary after laparotomy to make a second incision, it should be made at a considerable distance from the first, and in such a position as not to cut the larger vessels supplying the bridge of tissue lying between the two. It is better, where there is no evidence of suppuration in the first incision, in reopening the abdominal cavity to excise the tissue which is immediately adjacent to it. If the wound is suppurating, it is, of course, necessary to make the second opening at as great a distance from it as is feasible.

EMPHYSEMA OF THE ABDOMINAL WALLS.

Occasionally after a laparotomy where the incision is closed in layers and where there is a loose wrinkled skin, air escapes from the abdominal cavity into the connective tissue between the skin and muscle and gives rise to an emphysematous condition of the abdominal walls. The condition might be mistaken for an infection of the wound with the *Bacillus aërogenes capsulatus*. The emphysema may persist for a few weeks, but finally disappears without causing any marked inconvenience.

ENEMATA.

Occasionally accidents have occurred in the use of enemata. After suture of the rectum or sigmoid, large enemata should not be given. One has only to watch the distention caused by allowing 0.5 to 1 liter of fluid to flow into the lower bowel

to appreciate the tension put upon the suture in such cases. Poisonous solutions can be given by mistake, and in one case coming under my observation the lower bowel and skin surrounding the anus were scalded by the use of a hot enema, the temperature of which had been estimated only by the hand. The nozzle of a syringe has been thrust into the wound instead of the lumen of the bowel in a few cases where the operation was the restoration of a ruptured rectovaginal septum or other operation on the tissues surrounding the anus. These accidents are mentioned that they may be avoided.

Irrigations, Douches.—Cases of mild post-operative cystitis have been much aggravated by the use of a strong antiseptic or irritating irrigation of the bladder by mistake.

Likewise it occasionally happens that in giving a vaginal douche or in irrigating a drainage tract the irrigating fluid enters the general peritoneal cavity. This accident is liable to occur when the irrigation is used immediately after a drain or tampon has been removed and before adhesions have had time to shut off the cavity of the peritoneum, or when undue force is used in giving the irrigation. Hydrogen peroxid is, owing to the gas formation, which takes place when it comes in contact with pus or blood, especially liable to force its way into the abdominal cavity.

The entrance of the fluid into the abdominal cavity is attended by severe pain, the symptoms of shock, and usually later by a rise of temperature. In most cases very little fluid enters the cavity and no serious results follow, but peritonitis, local or general, may supervene, or poisoning due to absorption of the drug may ensue.

In clean cases where little fluid enters the abdomen it suffices usually to place the patient in a position to favor drainage, and to administer morphin and stimulants. If there should be much pus carried in, or if a considerable quantity of a mercuric chlorid or other poisonous solution should enter and not return, it is necessary to open the abdomen and sponge out the fluid. When the solution is not a poisonous one, the chief danger lies in carrying in pus and bacteria, and thus setting up a general peritonitis. In such cases the patient should be carefully watched for forty-eight hours, and if it should be apparent that a peritonitis is present the exploratory operation is indicated.

FOREIGN BODIES LEFT IN THE ABDOMEN AFTER OPERATION.

Gauzes, sponges, instruments, drainage-tubes, and other foreign bodies have been left in the abdominal cavity after operation and are a source of serious danger to the patient. Neugebauer has recently¹ collected 195 cases of the kind. Gauzes and sponges are the articles usually left behind. Such accidents are most liable to occur: in long and difficult operations; in conditions where due deliberation

¹ v. Neugebauer, F.: "87 neue Beobachtungen von zufälliger Zurücklassung eines Suboperatione benutzten Freundkörpers (Arterien Klemme, Schere, Schwamm, Gazetupfer, Mullkompreß usw.) in der Bauchhöhle Samt einigen anderen unvorhergesehen Zufällen intra Operationen," Zentralbl. f. Gynäk., Leipz., 1904, iii, 66-81.

cannot be exercised—such as hemorrhage, shock, etc.; and when there is difficulty in exposing the field of operation, due to fat, tympany, straining, etc. In such cases many pieces of gauze and numerous sponges are needed, and unless a good system is exercised in keeping a count of the number so used, a mistake is liable to be made. Without a systematic count by an assistant or nurse, the operator would leave such articles in the peritoneal cavity more frequently than is now the case.

In clean cases when a good technic is used the article so remaining, especially if small, may become encysted and do no great harm. This, however, is not the usual result, for by the irritation caused by the foreign body a peritonitis (generally local) develops, and unless the patient dies as a result of it, the body has either to be removed by another operation or to work its way out through the abdominal wall, vagina, bowel, or bladder. This result is brought about by the suppuration produced by the body and the breaking down of tissue near it. The bacteria of suppuration may be introduced during the operation, may be brought by means of the circulation, or make their way through the wall of the intestine after this has been weakened by inflammation and pressure. If the abscess opens into the intestine an exhaustive and prolonged diarrhea may result, or when the bladder is invaded cystitis, at times, followed by suppuration of the kidney is seen. In most cases the adhesions which form around the body involve the intestines and interfere with their peristaltic movements or encroach upon their lumen. Hence ileus, complete or partial, is frequently seen. Some authors have given drainage-tubes and other foreign bodies which have been left in wounds or in the abdomen as a cause of persistent mania.

The foreign body may cause symptoms to arise almost immediately after operation, especially where it is not sterile or where its presence interferes with the movements of the bowels. In other instances definite symptoms may not arise for weeks. In most cases, however, if the body is not very small the symptoms finally become so marked as to make a secondary operation necessary. In nearly all cases there is an elevation of temperature, an increased rapidity of pulse, interference with the functions of the bowels or bladder, and finally the body causes a definite abscess, which may point in the abdominal wall, vagina, bladder, or intestine.

How to avoid this distressing accident is a most important question. The following rules have been found of service:

1. Begin the operation with a definite number of sponges, gauzes, and instruments, and if more are needed have the nurse get out the same number or simple multiples of them.
2. Make the assistant or nurse who hands these articles responsible for their proper count.
3. Do not change assistants or nurses until the articles used are all accounted for.
4. The discarded gauzes and sponges should be placed in a special receptacle provided for them, and none should be removed from the operating room until the abdomen has been closed.

5. No gauzes or sponges should be divided during operation.
6. Use large pieces of gauze when packing off the intestines and have a piece of tape sewed to each. Some articles should be attached to the other end of the tape; clamps, or the colored and perforated marbles, being generally used for this purpose.
7. At the end of the operation the operator should demand to know of the persons responsible the number of articles missing, and should, even if all are accounted for, make a careful search of the field of operation to confirm the correctness of the reply.

After the discovery that a foreign body has been left in the abdomen is made, no time should be lost in removing it. In most cases the secondary operation is performed for the conditions caused by foreign body and the diagnosis is made as a consequence of the operation. The wound is treated upon general surgical principles, drainage being indicated in most cases.

Bodies Left in Wounds.—Occasionally non-absorbable sutures, drainage-tubes, or pieces of gauze drains are not removed at the proper time and are a source of annoyance and, at times, of actual danger to the patient. Silkworm-gut sutures which are used inside the vagina are the articles most often left behind, their removal being in many cases quite difficult, especially in nervous women.

Occasionally after hysterectomies and other operations where a vaginal drain is used a piece of gauze is left behind and may cause much trouble. Urinary and fecal fistulas occasionally result, and the dense intestinal adhesions which form in most cases may interfere seriously with the movements of the bowels.

Only a conscientious and systematic performance of duty by hospital assistants and a careful record of the number of sutures and gauzes used and removed will prevent the occurrence of these accidents. A good rule in all cases is to make a careful examination of the patient at the time of her discharge. This will prevent the occurrence of many of these accidents which are so humiliating to the operator and annoying to the patient. When a suture is cut off and left behind, it is wiser to anesthetize the patient, if necessary, and remove it before she leaves your care.

In operations upon or examination of the bladder cotton pledgets are occasionally left behind. When glass catheters are used they are liable to be broken and a piece left in the bladder, or short catheters may escape from the hands of the person using them and slip entirely into the organ. Likewise sutures which have been tied inside of or entered the mucous membrane of the bladder have to be removed, as they tend to become nuclei for calculus-formation.

The foreign body may be passed with the urine and give no trouble, but where this does not occur it is usually the source of much discomfort or serious danger to the woman. The symptoms are usually those of cystitis, with or without pyuria or hematuria.

The diagnosis can be made by means of a cystoscopic examination. This is most readily done by means of the Kelly cystoscope, by the use of which the nature of the trouble can be ascertained and the cause generally be removed.

If a foreign body is present and it is of a size to permit its passage through the cystoscope, it can be grasped by an alligator forceps and removed. In this way one can remove pledgets, rubber bougies, and other foreign bodies. Ligatures may in like manner be pulled away with or without being severed. If the body is too large to permit its removal in this way, an incision should be made through the vesicovaginal septum, or in rare cases a suprapubic operation is indicated.

POST-OPERATIVE THROMBOSIS, THROMBOPHLEBITIS, AND EMBOLISM.

The relation existing between these affections is so close that they will be considered together, and a brief general consideration of them will perhaps not be superfluous.

A thrombus is:¹ "A solid mass or plug formed in the living heart or blood-vessel from the constituents of the blood. . . . A thrombus formed from the circulating blood is at first parietal or mural, but by continued growth it may fill the vessel, and thus become an occluding or obstructing thrombus. A primitive or autochthonous thrombus, caused by local conditions, may be the starting-point of a continued or propagated thrombus, extending in the course of the thrombosed vessel and perhaps into communicating vessels. A secondary or encapsulating thrombus is one which starts from an embolus of thrombotic material. A continued thrombus is also spoken of as secondary. . . . The thrombus grows in length chiefly in the direction of the current of blood; but it may grow in the opposite direction. . . . A venous thrombus extends in the circulating blood, not only as far as the next branch, but frequently a greater or less distance beyond it in the form of a mural thrombus."

Thrombi are also subdivided into cardiac, arterial, venous, or capillary, accordingly as they occupy one of these portions of the circulatory system.

The general causes of primary thrombosis are given as follows: A slowing or other disturbance of the blood-current, changes in the vessel wall, and change in the blood itself.

The following classification, having as a basis the causation of thrombi, has also been made:

1. Inflammatory thrombi, which are produced through acute or chronic inflammation of the blood-vessel wall. As a consequence of the inflammation, the vessel wall is thickened and the endothelium injured.
2. Traumatic thrombi produced through injuries to the endothelium by trauma. To this classification belong those thrombi caused by ligation, severing, or tearing of the vessel.
3. Compression or dilatation thrombi which are caused by a slowing of the blood-stream. The compression can come about by tumors, exudates, etc.; and the dilatation may be due to actual disease, loss of elasticity, or excessive thinning of the vessel.

¹ Welch, W. H.: Allbutt's "System of Medicine," 1898, vi, 155.

4. Marantic thrombi which are due to diseased conditions of the blood, weakness of the heart, and slowing of the blood-stream.

The causes just mentioned may act conjointly after operation to produce thrombosis of the vessels. It is a well-established fact that thrombi are very liable to occur after operations for myomas or carcinomas of the uterus and large ovarian tumors. In these cases the blood-formation is interfered with by loss of appetite and general ill health produced by the pressure of the tumor causing deficient peristalsis and chronic intestinal obstruction; the nutrient material of the blood is utilized in supplying nutrition to the rapidly growing tumor; and in many cases large quantities of blood are lost both before and during operation. From these causes there is frequently in these patients marked anemia (the hemoglobin being at times reduced to 20 per cent. or to 30 per cent. of the normal), the number of white blood-corpuscles and blood-platelets and the amount of fibrin are relatively increased, and the blood is thus apparently rendered more liable to coagulate. Likewise in many of these cases there are pathologic changes in the blood-vessels and at times diseased conditions of the heart. Pozzi, Mahler, Hofmeier, and others have reported cases which apparently show that in women with these tumors the heart is liable to hypertrophy and dilatation and the heart muscle to undergo atrophic or other changes. The diseased condition of the blood tends to cause pathologic changes in the endothelium of the vessels, and in consequence of pressure, torsion, etc., the veins of the pelvis and lower extremity are liable to become dilated and their endothelium diseased. Finally, where *infection* is present this may act as a cause of thrombosis by causing inflammation of the vessel wall as well as by producing changes in the blood.

Clamped and ligated vessels may be the seat of the primary thrombus which by its growth so involves the larger trunks as to produce symptoms, or the vessels of the pelvis or abdominal walls may be so injured by the pressure of the retractors as to be the seat of thrombus formation. The work of Carrel and Guthrie seems to show that injury of the vessel wall by infection, trauma, etc., has more influence on thrombus formation than changes in the blood. Experiments by Schwab upon blood-coagulation tend to confirm this assumption.

Tuberculous cachexia, chlorosis, gout, and almost all of the infectious diseases are given as causes of thrombosis, and some of them are, at times, etiologic factors in the post-operative variety of the affection.

Although thrombosis may occur in any portion of the vascular system it is essentially an affection of the veins. As a post-operative affection much attention has been recently attracted to the so-called phlebitis or thrombosis of the femoral vein. The chief interest of the gynecologist and abdominal surgeon lies in the occurrence of thrombosis in the iliac veins, their branches (especially the femoral), the ovarian vein, the portal vein, and the mesenteric arteries and veins.

The symptoms produced by a thrombosis depend upon whether the vessel is an artery or a vein, whether it is partially or entirely occluded, whether the thrombus is bland or infected, and the location of the thrombus. Under favorable circum-

stances the lumen of the vessel is not totally occluded, or the collateral circulation is quickly established, so that the symptoms are not marked.

Arterial thrombosis except as secondary to embolism is extremely rare as a post-operative complication. The point where we usually see it is an artery of the lower extremity. The symptoms are as follows:

At first there is pain, which is usually severe, paroxysmal, and is increased by pressure over the vessel. The artery may be felt as a hard, sensitive cord, and below the thrombus the pulsation of the artery may be completely obliterated. The leg, especially about the ankle, becomes pale, cold, numb, loses in a varying degree its muscular power, and may be very sensitive to pressure. The skin may become mottled, edema is usually present, and unless the collateral circulation is quickly established or the vessel is not completely plugged, gangrene is the usual result.

Thrombosis of the veins is more frequent than arterial thrombosis as a post-operative complication. Schenck¹ states that after 7130 gynecologic operations in the Johns Hopkins Hospital there occurred 48 cases of thrombosis of the veins of the lower extremity. The operations after which the thrombosis occurred were as follows:

Perineal alone	4
Ovarian cysts	9
Hysteromyomectomy and myomectomy	19
Hysterectomy for carcinoma	5
Suspension of the uterus	3
Suspension of the uterus with repair of the perineum	4
Hysterectomy for pelvic inflammation	1
Miscellaneous	3

Albanus² found that in 1140 laparotomies in the new General Hospital at Hamburg-Eppendorf there occurred 53 cases of recognized venous thrombosis. All except one occurred either in the pelvic veins or the veins of the lower extremity. The diseases for which the operations were performed were as follows:

Carcinoma of esophagus	1
Diseases of stomach	8
(Carcinoma, 6; ulcer, 1; pyloric stenosis, 1.)	
Diseases of the vermiform appendix	10
Diseases of the large bowel (all carcinomas)	3
Diseases of the liver and appendages	7
(Liver abscess, 1; carcinoma of liver and gall-bladder, 1; chronic icterus, 1; diseases of the gall-bladder, 4.)	
Subdiaphragmatic abscess	2
Ileus, 1; perforative peritonitis, 1; general carcinoma, 1; sarcoma of the abdominal wall, 1; tuberculous peritonitis, 1.	
Total	5
Diseases of the female genital tract	19
(Carcinoma of ovary, 3; carcinoma of uterus and ovaries, 1; carcinoma of uterus, 1; pyosalpinx, 5; ovarian cysts, 4; myoma uteri, 3; prolapsus uteri, 1; extrauterine pregnancy, 1.)	

¹ Schenck, B. R.: "A Résumé of Forty-eight Cases of Post-operative Crural Thrombosis," N. Y. Med. Jour., 1902, lxxvi, 401-404.

² Albanus, G.: "Thrombosen und Embolien nach Laparotomien," Beitr. z. klin. Chir., 1903, xl, 311-330.

Sonnenburg in 1000 operations for appendicitis observed 20 cases of thrombosis. These were distributed as follows:

Right leg.....	9
Left leg.....	6
Both legs.....	2
Vena porta.....	2
Vena cava.....	1

Clark¹ in 3000 celiotomies performed mainly for gynecologic diseases found 35 cases of femoral thrombosis. The diseases were as follows:

Myoma uteri.....	16
Cystoma ovarii.....	10
Retroflexio uteri (simple and adherent).....	5
Carcinoma uteri.....	5
Appendicitis.....	2
Salpingitis and peri-oöphoritis.....	2
Floating kidney.....	1
Cancer of pylorus.....	1

The occurrence of thrombosis in the veins of the lower extremity is thus seen to be not of infrequent occurrence. One generally sees the affection involving the femoral vein. In the first 39 cases of femoral thrombosis which were observed in the gynecologic wards of the Johns Hopkins Hospital, 28 occurred in the left leg, 8 in the right, and 3 in both legs at the same time. The shortest time in which symptoms of "phlebitis" made their appearance after operation was seven days, the longest twenty-eight, and the average time sixteen days. The affection has followed nearly every form of gynecologic operation, cases having been seen after curetage, suspensio uteri, appendicectomy, kidney operations, hysterectomy, peri-neorrhaphy, etc., but it occurs more frequently after the removal of large pelvic tumors, and carcinomatous uteri. After these operations most of the conditions are present which favor thrombus formation; *i. e.*, there is anemia; the heart is, at times, diseased, and there is slowing of the blood-stream due to lack of muscular exercise, the recumbent posture, etc.; the veins of the lower extremity are, in consequence of pressure by the tumor, dilated and their walls diseased; the pelvic veins are likewise dilated and tortuous, and by ligation, bruising by clamps and retractors are liable to be the seat of the primary thrombus. Clark lays especial stress on the probability of the epigastric veins being the starting-point of the thrombi which finally plug the femoral vein.

Infection is also an undoubted factor in a certain number of cases.

The increased frequency with which thrombi occur in the left femoral vein is thought to be due to the greater length and obliquity of the left iliac vein; and to its passage beneath the rectum or sigmoid flexure of the colon and the right iliac artery. Pressure by these structures doubtless causes an increased tendency to thrombus formation. This pressure is increased when the lower bowel is distended by fecal matter or a large enema. Of greater importance, I believe, as an explanation of this increased frequency is the following: Owing to its greater length and

¹Clark, J. G.: "Etiology of Post-operative Thrombo-phlebitis," Univ. Penna. Med. Bull., Phila., 1902, v, 145, 146.

its course obliquely across the posterior wall of the pelvis, this vessel is subjected to greater pressure and trauma *before operation* in cases of myomas and other large pelvic tumors. As we have seen, femoral thrombosis occurs much more frequently in cases of these tumors. They press more directly on the left iliac vein than on the right one, and there is consequently a greater tendency to dilatation of the vessel walls and to changes in the endothelium of the veins of the left leg. As a consequence of this dilated condition of the vein and change in its endothelium there is an increased tendency to thrombus formation *after operation*.

In those cases where thrombosis takes place in both femoral veins the process in the second is generally an extension of the thrombus from the side first involved by way of the common iliac veins.

The *symptoms of thrombosis* of the pelvic veins where the external iliac is not involved are obscure. We see cases of pulmonary embolism following thrombosis of these veins when the convalescence of the patient had apparently been normal. One would expect some elevation of temperature, an increased pulse-rate, and pelvic pain. These symptoms are seen so frequently after celiotomies that their value in diagnosing thrombosis of these veins is small. An elevation of temperature to 100° to 103° F. after the first week, a relatively rapid pulse, the occurrence of a sudden sharp pain in the chest, or a localized pleurisy are indicative of thrombosis of the pelvic veins.

In *thrombosis of the femoral vein* there is a sudden elevation of temperature to 100° to 103° F., seldom preceded by a chill or chilly sensations. It has been stated that there is a relatively greater increase in the pulse-rate than usually accompanies this amount of fever; the pulse curve is irregular, at times going very high, and the pulse may remain rapid after the fever subsides. This relation between pulse and temperature was not a striking feature in my cases and would not have aided materially in making a diagnosis even after the condition was suspected. Pain is usually the first symptom to attract attention. It may be quite severe and paroxysmal, or only tenderness along the vessel and pain on movement of the affected leg may be present. The pain is worse in the groin, inside of the thigh, popliteal space, and calf of the leg. Pricking and tingling sensations are frequently felt. The edema, which varies greatly in amount, makes its appearance early in the course of the affection. It may be scarcely noticeable, moderate in amount, or the limb may be firm with the skin smooth and tense. The leg in marked cases pits on pressure and is white and mottled in appearance. The vein can, at times, be felt as a hard cord, especially if superficial, where it may be seen as a line of livid red color. The surface temperature is frequently elevated in acute cases. Muscular movements are generally restricted, principally on account of the pain. The symptoms may be more pronounced than the ones described above. In typical phlegmasia alba dolens the symptoms are more marked, the leg being quite elastic and pitting but little on pressure. Krönig found in a case of phlegmasia, streptococci in the fat and connective tissue outside the blood-vessels, and in typical phlegmasia there is probably lymphangitis and occlusion of the lymph-channels as well as phlebitis.

It is very interesting and important to know what finally becomes of the thrombi. They may soften or break down, become organized, or undergo calcification. The softenings are divided into simple or bland, septic or purulent, and putrid. The simple softening is thought to be due to the action of a ferment, and the septic and putrid are due to the action of the pyogenetic and putrefactive bacteria respectively. These softenings may lead to the dislodgment of pieces of the thrombi, which are then known as emboli, and these are transported by the circulation to various parts of the body. When calcification occurs phleboliths or arterioliths are formed.

The organization of thrombi, *i. e.*, the substitution for the thrombus of vascularized connective tissue takes place in the majority of cases. The tissue which replaces the thrombus is derived from the wall of the blood-vessel, new blood-vessels springing from the vasa vasorum, and the endothelium and connective tissue being derived from like cells in the vessel wall. Lacunar spaces lined with endothelium may form throughout the thrombus, the latter becoming gradually disintegrated and absorbed. The newly formed tissue becomes fibrous and contracts and there may result a fibrous plug, a cavernous structure with blood-spaces, or a restoration of the lumen of the vessel with perhaps a few bands crossing it.

The *prognosis* of a thrombosis of the veins of the lower extremity is usually very good, the chief danger being pulmonary embolism. Pulmonary embolism occurred twice in the 48 cases of thrombosis reported by Schenck, but neither proved fatal. Albanus in his 1140 cases of laparotomy saw 23 cases of embolism, all but one occurring in the lungs. Riedel reports 4 cases of thrombosis, one of which died of pulmonary embolism. In Sonnenburg's series of 1000 cases of appendicitis, with 20 cases of thrombosis there were 3 deaths from pulmonary embolism and 2 from what he considered to be embolic pneumonia. In 86 autopsies upon cases where death was due to appendicitis, Kelly and Hurdon found 3 cases of pulmonary embolism. The *sequelæ* are, as a rule, not marked. There is usually a slight edema, especially upon using the limb, for several weeks, accompanied by stiffness and pain, and in exceptional cases we see chronic edema, stiffness and pain, which persist for months or years. Elephantiasis, varicose veins, chronic ulcer, neuritis, muscular atrophy or hypertrophy, and club-foot are also given as sequelæ. Gangrene perhaps never occurs in uncomplicated cases.

The *prophylaxis* of post-operative thrombosis consists in scrupulous asepsis, in care during operation to prevent undue bruising and trauma of the blood-vessels of the abdominal wall and pelvis, and in improving the general condition of the patient before operation, when possible, by rest in bed, good food, careful attention to the condition of the bowels, and the administration of iron, arsenic, etc., to increase the amount of the hemoglobin.

The *indications for treatment* are two: to prevent the occurrence of pulmonary embolism, and to promote the absorption and organization of the thrombus. These indications are met by rest, position, and general hygienic rules. In femoral thrombosis the patient should remain in the recumbent position for six weeks with

as little movement of the affected limb as is possible, the limb should be well wrapped in some soft substance, kept slightly elevated, and have applications of soothing lotions, as lead-water and laudanum, once or twice a day. Rubbing and tight bandaging are absolutely contraindicated. The usual rules relating to the general condition of the patient are applicable to these cases. After six weeks, if the local symptoms have all disappeared, the danger of embolism may be considered as past, and gentle massage and bandaging may be employed or an elastic stocking may be worn. When gangrene occurs amputation of the limb is necessary.

Embolism.—Embolism is defined as the impaction in some part of the vascular system of any undissolved material brought there by the blood-current. The transported material is called an embolus. The emboli are usually dislodged pieces of thrombi, but may consist of fat, air, tumor-cells, etc. A thrombus from the systemic veins or the right heart causes a pulmonary embolism except in those rare cases of crossed embolism where the embolus passes through an open foramen ovale. When a piece of a thrombus is detached from the left side of the heart, the pulmonary veins, or the systemic arteries, the embolus lodges in a systemic artery.

Fat emboli are of little importance in gynecology, although some authors think that under certain conditions they cause lung complications. *Air*, which occasionally enters the veins during operation, causes signs of cardiac embarrassment and at times death. This form of embolism is extremely rare after abdominal operations.

Pulmonary embolism is the one of chief importance. This is of comparatively frequent occurrence, much more so, perhaps, than is generally believed. The principal sources of pulmonary embolism following gynecologic and abdominal operations are the ovarian and the branches of the common iliac veins. There seems to be a special liability for pulmonary embolism to occur after operations for ovarian tumors, myomas, carcinomas, and incarcerated herniæ. The embolism generally takes place between the first and fourth week after the formation of the thrombus, although one sees it not infrequently within a few days after operation, and occasionally also later than the fourth week.

In a considerable portion of the cases of pulmonary embolism the thrombi exist at the time of operation, and the embolus is set free either by the manipulation of operation or by the removal of pressure in the veins. In a case seen in Zweifel's clinic the fatal pulmonary embolus coming from the femoral vein followed the drainage of an abscess in the right iliac region.

The *symptoms* of a pulmonary embolus depend upon the size of the vessel which is obstructed, the rapidity and completeness of the obstruction, the nature of the embolus, and the general condition of the heart, lungs, etc., of the patient. When the embolus is large and the pulmonary artery, its chief branches, or, it may be, one of them is plugged, death may be instantaneous or ensue in a few minutes. Usually the patient gives a sharp cry, sits up suddenly in bed, complains of great precordial distress, and gasps for breath. The auxiliary muscles of respiration

stand out prominently, the cervical veins are distended, and the patient shows marked signs of collapse. The heart's condition may be tumultuous, or slower than usual. It is generally weak and irregular. The pulse varies greatly, in some cases slow, full, and irregular, and in others almost imperceptible at the wrist. There is pallor followed by cyanosis. One sees at times convulsions and opisthotonos. The patient usually dies from syncope. The physical signs do not indicate the lesion, the full stridulous breathing being the only thing brought out usually by an examination of the chest. When the embolus does not totally occlude the vessel or vessels, the patient may live several hours and die as a result of the secondary thrombosis, and here the same symptoms are seen, but they are not so pronounced as in the rapidly fatal cases. When a small vessel is plugged there results usually a hemorrhagic infarction of a limited extent. The occurrence of the infarction is indicated by chilly sensations, dyspnea, pain in the chest, and localized pleurisy. Blood-stained sputum is frequently seen and profuse hemoptysis is occasionally present. Examination of the lungs may show changes, but the diagnosis cannot be made in most cases by means of it, as it is generally impossible to differentiate these cases from some other affections of the lungs which follow serious operations in which anesthesia has been employed, such as bronchopneumonia. Even after grave symptoms have arisen in pulmonary embolism the patient may recover. If the embolus is infected, the effects and symptoms are those of bland emboli, to which are superadded the specific effects of the bacteria with which they are infected, and abscesses, gangrene, etc., may supervene.

The *diagnosis* is based upon the sudden and characteristic symptoms and the existence of a recognized source of an embolus. In any case where a pleurisy of a limited extent or evidence of small areas of pulmonary inflammatory changes is seen after operation, the probability of an embolic cause should always be considered.

The *treatment* is for the most part prophylactic. After the embolism has occurred little can be done. Hypodermic injections of camphor or brandy should be used to control the collapse, and if the cyanosis is marked, oxygen should be administered. Unfortunately, in most cases one suspects nothing until the patient suddenly dies of an embolus from one of the thrombosed pelvic veins. Following operations nurses should be trained *not to rub* the lower extremities of the patients who complain of pain there, without instructions. In cases of post-operative pleurisy, or sudden sharp pain in the chest with rapid and irregular pulse, the surgeon should think of embolism and precautions should be taken to keep the patient quiet.

Embolism and thrombosis in the veins or arteries of the intestines are of great interest to the surgeon, and occasionally occur, after laparotomies, as a result of incarcerated hernia, after appendicectomy, and in certain cases of intestinal obstruction. Delatour reports a case following splenectomy. The *symptoms* of thrombosis and embolism in this region are essentially the same. In the majority of instances they occur in the superior mesenteric artery or its branches. An embolism of an artery or a thrombosis of a vein or artery of considerable size is generally followed by a hemorrhagic infarction of the intestines. The infarction

may be complete or partial, and its extent depends upon the size of the vessel plugged. The symptoms may be slight if the thrombosed vessel is small, and it is probable that many of the post-operative ulcers of the stomach and intestines are due to the occurrence of an embolus or thrombus in a vessel supplying the part. In the recognized cases the symptoms are well marked and extremely severe. At first there is intense colicky pain and abdominal tenderness, and this is quickly followed by all the signs of intestinal obstruction, to which are generally added the presence of dark tarry blood in the stools and the vomiting of bloody material. The symptoms are practically those of acute obstruction of the intestines and the case is usually so diagnosed and treated. One finds on opening the abdomen that the affected intestines are distended, thickened, edematous, and of a dark red color. The peritoneal covering is lusterless and covered with a fibrinous or fibrino-purulent exudate. There may be a general peritonitis, as the bacteria from the intestine quickly invade the general cavity. Bloody fluid may be found in the peritoneal cavity. The mucous membrane of the affected intestine is in places necrotic and, at times, covered with a diphtheritic membrane. The mesentery is edematous, thickened, and contains extravasated blood. The *prognosis* is very grave, but a few cases of infarction of the intestine have recovered following resection of the infarcted portion.

The *treatment* is either symptomatic in cases of ulcers, or in severe cases that given for ileus with gangrene.

An **embolism** or a rupture of one of the blood-vessels of the brain may occur during anesthesia or as a post-operative complication. The symptoms of the two affections being almost identical, they will be considered together. The stage of excitement of the anesthesia would seem to be the time when a rupture of a vessel would be most likely to take place. When an embolism occurs the plug usually lodges in the middle cerebral artery. In some of these cases the patient does not regain consciousness after the operation; in others the symptoms which indicate the lesion are found when she comes from under the effects of the anesthetic; and in others still, especially in embolism, the symptoms may develop at almost any time during the convalescence. Hemiplegia, hemianesthesia, crossed paralysis, and other well-known symptoms may be present. In embolism the premonitory signs are absent, the prognosis is more favorable, and the duration of the paralysis, etc., is shorter, as a rule, than in apoplexy. If the embolus is infected an abscess may result, but in some cases of embolism the patient soon regains the use of the paralyzed muscles. These complications are rare after gynecologic operations, but I have recently seen two cases of post-operative cerebral embolism in the service of I. S. Stone at the Columbia Hospital in Washington, D. C., one following the removal of a myomatous uterus and the other after a gall-bladder operation. Byron Robinson reports several cases in which he thought death was caused by an embolism in the floor of the fourth ventricle, as both cardiac and respiratory centers seemed paralyzed at once.

Thrombosis or embolism of the coronary arteries of the heart may excep-

tionally occur after operation, and should always be considered in looking for the cause of sudden death.

Thrombosis and embolism may occur in the vessels of the **spleen and kidney** after operation. Infarcts of these organs frequently result from such conditions and abscesses of embolic origin are sometimes seen in them in cases of pyemia. The diagnosis of an infarct cannot be made with any degree of certainty when suppuration is not present. In infarction of the kidney, pain and hematuria are generally present, while in splenic infarction pain and a splenic friction rub are the chief diagnostic symptoms. When abscesses ensue there is fever, enlargement of the organ, and in case of kidney abscess pyuria is generally seen.

Thrombosis of the portal vein may occur after operation and is usually of the septic variety. The infectious process may invade the vein from foci in its vicinity, such as follow operations upon gall-bladder or bile-ducts, or extend to the vein from one of its tributaries. A number of cases of infected pylephlebitis and liver abscess have been reported following operations upon the vermiform appendix. Gerster¹ in 1189 cases of appendicitis saw 9 cases of septic pylephlebitis. He says: "The primary thrombus is seen extending gradually and continuously or, in short intervals of space, upward toward the center, rarely involving the entire circumference of the lower course of the portal vein, but more commonly forming laterally adherent thrombi, alongside of which the blood-current may pass with little interruption. Completely obturating thrombi are generally found near and about the entrance into the liver, either in the trunk of the portal vein, which is rare, or more commonly in one or the other or in both of its branches. The process of infection is a slowly progressive one by continuity, and results in the formation of a more or less extensive septic thrombus of unequal mass and thickness and of varying consistency."

Quinke considers appendicitis second only to dysentery as a cause of liver abscess, and then, in frequency, follows cholelithiasis. Langfeld in 112 cases of appendicitis saw pylephlebitis four times. Fitz in 257 cases of appendicitis saw pylephlebitis and infection of the liver in 11 cases. Hart, Sonnenburg, Bärensprung, Kelly, and numerous other writers report cases of the same kind.

The thrombotic process may extend to the portal vein through the mesenteric veins from the intestine, or by anastomosis from a pelvic vein due to an infection of the uterus or its appendages.

Thrombosis of the bland variety is probably of much less frequent occurrence in the portal vein.

"The diagnosis of obstruction of the portal vein can rarely be made. A suggestive symptom, however, is a sudden onset of the most intense engorgement of the branches of the portal system, leading to hematemesis, malena, ascites, and swelling of the spleen." (Osler.) Emboli occur much more frequently in the

¹ Gerster, A. G.: "On Septic Thrombosis of the Roots of the Portal Vein in Appendicitis and on Pylephlebitis, together with Some Remarks on Peritoneal Sepsis," *Med. Rec., N. Y.*, 1903, lxiii, 1005-1015.

branches of the portal vein, but do not, as a rule, lead to infarction of the liver. "Although the intrahepatic artery and portal vein are terminal vessels, their capillary communications are so abundant that, as a rule, embolism or thrombosis of the hepatic vessels causes no interference with the circulation of the liver." (Welch.)

When the embolus occurs in an artery of the extremities, the symptoms are almost identical with those described under arterial thrombosis. In embolism the advent of the pain is more sudden and severe, and this, with the existence of a lesion of the left heart, would serve to distinguish it from thrombosis.

POISONING BY DRUGS.

It is impossible in this chapter to go into the symptoms and treatment of poisoning by every drug, but a few words to indicate how to recognize the cases which are liable to follow operations and to point out the more common symptoms of the important ones will perhaps not be out of place.

In **purpuric rashes** one should always consider quinin, mercury, copaiba, belladonna, ergot, and the iodids as possible causes. Very small quantities of these drugs may call forth extensive ecchymoses. Osler reports a case of marked purpura in a man after the administration of the iodid of potash for ten days. I have recently seen a young woman who, after taking two grains of quinin in combination with iron and strychnin, developed extensive purpura. She had an idiosyncrasy for the drug, having had a similar eruption on two other occasions from taking it.

Erythema may arise after the administration of many drugs, chief among which are quinin, belladonna, cannabis indica, hyoscyamus, stramonium, chloral hydrate, antipyrin, opium, and carbolic acid.

Eruptions having the form of papules, vesicles, or pustules may follow the administration of the bromids, iodids, mercury, arsenic, and a few other drugs.

Urticaria, at times, follows the administration of opium, belladonna, cannabis indica, turpentine, etc.

Insanity is reported to have occurred after the use of iodoform, belladonna, eserine, salicylic acid, and the salicylates.

The post-operative administration of **strychnin** as a routine is followed in many clinics, and symptoms of poisoning are occasionally seen. The first indications of strychnin poisoning are stiffness of the muscles of the neck and face, increased reflex muscular excitability so that a sudden noise or touch causes a violent movement, muscular twitching, and restlessness. Finally opisthotonos and the classic symptoms arise.

In poisoning by **atropin** and other members of this group the characteristic symptoms are dilated pupils, dryness of the mouth and throat, quickened pulse and respiration, rash, restlessness and garrulity, and finally depression, ending in stupor and coma.

In **opium** poisoning the diagnosis is based upon the following symptoms: Drowsiness followed by deep sleep, contracted pupils, slowed respiration, the num-

ber of which may finally be only three or four to the minute, with cyanosis and dryness of the mouth and throat.

Poisoning from **mercury** is perhaps more liable to occur as a post-operative complication than from any other drug, many persons being very susceptible to its action. The administration of a few grains of calomel as a purgative, the irrigation of a raw surface, or the giving of a vaginal douche when a bichlorid solution is used may cause symptoms of mercurialization to arise. The symptoms first intimating this trouble are a foul breath, sore gums and teeth, increased flow of saliva, diarrhea, and a rash.

Iodoform impregnated in gauze or used as a dusting-powder is largely used as a surgical dressing, and occasionally poisoning from its use is supposed to occur. Cushny¹ gives the symptoms as follows: "The symptoms of iodoform intoxication in man generally set in with anxiety, general depression, and discomfort. The patient becomes sleepless and restless, complains of giddiness and headache, and often of the taste and odor of iodoform in the mouth and nose. The pulse is generally greatly accelerated, and a rise of temperature is said to have occurred in some cases in which no septic poisoning could be found to account for it. The depression deepens into true melancholia accompanied by hallucination, the patient often suffering from the illusions of persecution which may induce him to attempt suicide. As a general rule this melancholia is followed by attacks of violent delirium and mania lasting for hours and days, and in fatal cases by collapse and death. In other cases the condition has passed into permanent insanity and dementia. A rarer result of the absorption of iodoform is deep sleep passing into stupor and collapse without any sign of cerebral excitement."

In milder cases of poisoning the patient suffers only from the unpleasant taste and odor, from headache, and not infrequently from nausea and vomiting.

A rash and at times a dermatitis is seen after the use of this drug. The urine usually contains iodine, as can be shown by tests.

Most cases of iodoform poisoning in gynecology are due to packing large cavities with the gauze. In instances where an extensive use of the gauze is needed the excess of iodoform should be washed out of it before using it as a pack.

Carbolic acid poisoning as a post-operative complication is rare, but it may occur. It can arise from being taken internally or be absorbed from the skin, a wound, or a mucous membrane. When large quantities are absorbed, almost immediate unconsciousness may result and death take place in a few minutes. It is usually absorbed in small quantities, when there occurs headache, depression, nausea and vomiting, pallor, and collapse with irregular pulse and respiration. Fainting and unconsciousness may finally come on. Delirium and excitement are observed at times. The urine becomes a smoky, dark green color.

It is a good plan before the use of mercury, quinin, iodoform, or any drug which may produce unpleasant symptoms to inquire if the patient has a known idiosyncrasy for it.

¹ Cushny, A. R.: "Text-book of Pharmacology and Therapeutics," 1903, 521.

MALARIA.

Malarial paroxysms developing during convalescence are always startling, and in cases where the parasite cannot be found, the cause of the trouble may remain in doubt for days.

The **diagnosis** depends principally upon the history of the case, the nature of the temperature curve, the absence of any known cause for the chills and fever, and the blood examination. The points in the latter to be specially considered are: (1) the presence or absence of the malarial organism, (2) the positive or negative result of Widal's test, (3) whether or not there is a greater leukocytosis than one would expect during convalescence from the operation through which the patient had been. The presence of the organism would make the diagnosis positive, although this would not exclude some possible coexisting disease whose symptoms resemble those of malaria. A positive result from Widal's test would point to typhoid fever, while the absence of an increase in the leukocytes in the presence of fever would indicate typhoid or malaria. In suspected cases the blood should be carefully, and if necessary repeatedly, examined for the parasite before giving quinin. In malarial districts there is a tendency to attribute to malaria most unexplained elevations of temperature. There should be a careful examination of the seat of operation, chest, urine, bowels, etc., before quinin is administered in cases where the parasite is not found.

The **treatment** of malaria is not materially modified by the development of the disease after operation.

TYPHOID FEVER.

Occasionally typhoid fever arises after gynecologic operations, and is then a serious complication. In some cases the patient is suffering with typhoid at the time of operation and the proper diagnosis is not made, or the two diseases happen to be coincident, the gynecologic usually being chronic. Among our 9000 cases there is a record of 7 cases of typhoid fever. Of these, 3 were admitted with a diagnosis of some gynecologic disease and the error discovered after admission; 3 were operated upon for some gynecologic disease when the principal symptoms were due to typhoid; and in one case the fever developed several weeks after operation. The principal points in the diagnosis may be better impressed by giving briefly a few cases.

1. A girl fifteen years old was sent several hundred miles to the hospital with a diagnosis of some disease of the urinary tract. She gave a history of having had an attack of typhoid fever four years before admission. She had been complaining several months prior to the entrance to the hospital and "broke down" three weeks before admission. Upon admission she complained of headache, backache, anorexia, and burning micturition. Her temperature was 103° to 104° F.

The examination of chest and abdomen was negative and the rectal examination did not show anything abnormal.

The urine contained a trace of albumin, a few casts and pus cells, and gave the diazo reaction. Examination of urine for the bacillus of tuberculosis was negative. Hemoglobin 65 per cent. Leukocytes 8500. Widal's reaction was positive.

Diagnosis, typhoid fever. The patient was transferred to the medical department, where the disease ran its usual course and the patient was discharged well.

The diagnosis was based upon a negative physical and pelvic examination, a low leukocyte count, and a positive Widal reaction.

2. Another case, which was more deceptive, was the following: A chorus girl entered the hospital giving a history of having had a criminal abortion performed in another city three months before admission. This was followed by a pelvic abscess which had been drained through the vagina and a drainage-tube inserted. She entered the hospital with the drainage-tube still *in situ*. (It had been inserted three weeks before.)

She complained of fever, abdominal pain, malaise, and headache. Her temperature was 103° F. and her pulse 110.

The examination of the chest and abdomen was negative, and the vaginal examination revealed the drainage-tube and the opening into the cul-de-sac of Douglas, but was otherwise negative. Her urine gave the diazo reaction but was otherwise normal. The drainage-tube was removed and she was given antiseptic vaginal douches. The temperature rose to 104° F. in twenty-four hours. Her leukocytes numbered 5500 at the first count and 3300 at the second. Widal's test proved positive and rose spots could now be seen. The diagnosis of typhoid fever was made and she was transferred to the general medical department.

3. The following case was even more misleading, and in this there existed both the uterine disease and typhoid fever. The patient gave a history of a miscarriage fourteen weeks before admission to the hospital with almost continuous uterine hemorrhage since, accompanied with the passage of pieces of tissue. She complained on admission of abdominal pain, fever, and chills. The general examination was negative, and the vaginal examination showed an enlarged, tender, retroflexed uterus with a soft cervix and patulous os.

Temperature 102° to 104° F. Pulse 110. Leukocytes 7500. Urine negative. Operation: Curetment of uterus—small amount of curetings. The fever continuing, a Widal's test was made, which was positive, and rose spots appeared shortly after.

Diagnosis, typhoid fever.

She was discharged after the usual course of the disease.

4. In a fourth case the typhoid fever developed as the patient was convalescing from an acute attack of pelvic inflammation of gonorrheal origin. There were numerous intestinal adhesions, which after the onset of typhoid gave rise to chronic intestinal obstruction. An operation to relieve the obstruction was partially successful. The patient died, but whether of the typhoid or as a result of the obstruction was not determined.

In differentiating typhoid fever from suspected inflammatory affections the leukocyte count is of the utmost value. A low leukocyte count might decide the diagnosis in a doubtful case. Widal's test, when positive, is perhaps the most important sign in making a diagnosis. Diarrhea, the rose spots, the nature of the temperature curve, and the failure to find any lesion in the genital, urinary, or pulmonary tracts are likewise of much value.

In those patients who are suffering coincidently with typhoid fever and some suppurative gynecologic disease one is very liable to overlook the former. Many of these cases are sent to the hospital as emergency cases, and consequently are not, as a rule, studied as carefully as they should be. Only the most painstaking study of the case and the employment of the blood-count and the Widal test will enable one to arrive at a correct diagnosis.

The prognosis in typhoid fever patients who have undergone long or severe operations is, of course, much worse than it would otherwise be.

SYPHILIS.

The lesions of tertiary syphilis are the causes of many of the affections which fall into the hands of the gynecologist for treatment. A large percentage of the cases of stricture of the rectum, a certain proportion of those of rectovaginal fistula, and ulcerative processes connected with the vulva, vagina, and urethra are the result of the second or third stages of syphilis. The extreme difficulty in curing syphilitic fistulas and strictures is well known, and their treatment is given in other sections in this book. The occurrence of the secondary lesions of syphilis occasionally takes place after operations for other diseases. It is not infrequent that gonorrhea and syphilis are simultaneously contracted and the primary syphilitic lesions escape notice. The secondary lesions may in consequence make their appearance after an operation for an abscess of Bartholin's gland, an acute salpingitis, or pelvic abscess. The symptoms and signs of syphilis are usually so unmistakable that the diagnosis is not difficult. There is a manifestation of syphilis which is extremely interesting and which is rarely considered. This is **syphilitic fever**, one case of which came under my observation as a post-operative complication. The case has been reported in full by Fletcher.¹ Following an operation for pelvic inflammation the woman had an elevation of temperature, accompanied by fever and sweating. The case at first sight resembled malaria. The blood, however, proved to be free from the malarial parasite, and it was only when the secondary eruption developed, nearly one month after the appearance of the fever, that the diagnosis was made. Syphilitic fever may occur at various periods in the course of the disease. It may occur, as in our case, three or four weeks before the secondary skin eruption, it may occur with or immediately precede the eruption, or it may occur at any time during the course of the secondary or tertiary stages of the disease. The

¹ Fletcher, T. B.: "Syphilitic Fever, with a Report of Three Cases," N. Y. Med. Jour., June 22, 1901, 1065-1069.

occurrence of fever of obscure origin following an operation should make one consider syphilis as a possible cause. The absence of the malarial parasite from the blood of the patient; the absence of a leukocytosis; the negative results of Widal's test and the absence of other signs of typhoid fever; the failure of the patient to react from tuberculin and the failure to find a tuberculous lesion; and the absence of a focus of suppuration to account for the fever in obscure cases should cause one to suspect syphilis. A history of syphilis, the presence of the scar of the primary sore, or evidence of tertiary syphilis in the viscera or long bones would justify in such cases the administration of mercury and iodid of potassium. The fever promptly yields to these remedies.

HYSTERIA.

This disease may develop during convalescence and cause much anxiety to those upon whom the care of the patient devolves. While not in itself dangerous, it may lead to an incorrect diagnosis and subject the patient to treatment that is hurtful. The mistake which is more frequently made is in regarding some serious affection as hysteria. Cases of pulmonary embolism, nephritis, insanity, and other serious post-operative affections have been mistaken for hysteria. It would be superfluous to go into the symptoms and treatment, but I would warn the reader against being too prone to consider symptoms which arise after operation, and which cannot readily be explained, as hysterical. The diagnosis of hysteria should be made only after the most careful examination and exclusion of other more serious affections.

POST-OPERATIVE NEURASTHENIA.

Post-operative neurasthenia frequently makes its appearance before the patient leaves the surgeon's care, and therefore falls under the head of complications following operation. As in post-operative insanity, the predisposing cause is a neuropathic tendency which may be inherited, or which may be acquired by overwork, worry, exhausting diseases, the use of stimulants and narcotics, sexual excesses, dietetic imprudences, and the various other causes which are supposed to produce neurasthenia. The exciting causes may be placed in two large classes: (1) the shock, excitement, worry, fear, exhaustion, suppuration, etc., which are incident to operation; and (2) the disorders due to the artificial menopause produced by the removal of the ovaries, uterus, or both ovaries and uterus.

The cases falling under the first of these groups are seen as often after operations performed by the general surgeon as by the gynecologist, and bear a close resemblance to many cases of *traumatic* neurasthenia. The reader is referred to text-books on the practice of medicine for articles upon neurasthenia, as the post-operative variety of the affection cannot as yet be differentiated from the usual kinds.

In a woman whose uterus, ovaries, or both uterus and ovaries have been removed there results an artificial menopause, and the disorders which occur at

the natural change of life are seen here at times in an exaggerated degree. In these cases the cause named in group (1) operate also. The disorders of the menopause artificially produced are many and often severe. There are *flashes* or *flushes* of heat, palpitations, hystero-neuroses, and physical disturbances.

The flushes come on, as a rule, within a few weeks after operation and persist for periods of time varying from a few months to several years. Their intensity grows less, usually in a few months. They frequently appear every forty to fifty minutes while the patient is awake, and are sometimes preceded by a slight faintness, chilly sensations, or dizziness. The patient feels that she is pale and that the blood is leaving the surface of the body. This is followed by a wave of heat which rushes over the surface of the body, particularly the face and neck, causing burning, tingling, and flushing of these parts, and this is succeeded by sweating. The patient may complain of her heart beating very forcibly, the thumping of which she can hear. The flushes are nervous phenomena, the vascular system responding to the same sort of stimulus which causes blushing.

Palpitation and tachycardia, which may or may not accompany the flushes or be seen independently, are likewise due to a disturbed nervous system.

The hystero-nervous and psychic phenomena are those of other forms of neurasthenia, but are frequently seen in women who have previously been free from them.

The causes of the climacteric disturbances are not at all well understood. The cessation of both the monthly flow and the internal secretion of the ovary is a probable factor in producing them. The disturbed metabolism which results from suddenly causing the stoppage of a monthly loss of a considerable amount of blood, and the mental effect produced upon the patient who knows that her organs of procreation have been removed, must both act deleteriously upon the human organism. The removal of the ovaries, according to the belief of most observers, has more to do with the production of the climacteric phenomena. The ovary is assumed to have a secretion of its own whose proper regulation is necessary for the good health of the woman, and when this secretion is suddenly stopped there occur the symptoms noted at the menopause. This belief has so firm a hold in the minds of certain gynecologists that many of them try in all cases to leave behind at least a portion of one ovary.

The *treatment* of post-operative neurasthenia in general is that of other forms of the disease. Where the ovaries have been removed the administration of ovarian extract in doses of 2 to 5 grains three times a day has given in some cases very gratifying results. The hot flushes have in some reported cases ceased in forty-eight hours after beginning the administration of the drug. No disagreeable after-effects of the remedy have been noted. In estimating the therapeutic value of ovarian extract only those cases should be considered in which the patient is ignorant of the nature of the medicament; otherwise the effects noted may be due to psychotherapy. (For a further consideration of the subject see Vol. I, pp. 314-320.)

POST-OPERATIVE INSANITY.

Insanity following gynecologic operations may conveniently be divided into two classes: (1) Insanity which immediately follows operation as a result of the excitement, the anesthetic, nephritis, infection, etc.; (2) that form of insanity which follows the removal of the ovaries with the resulting production of the artificial menopause. The gynecologist has to deal with the first class, in which the affection comes on during the convalescence of the patient from the operation.

The removal of the ovaries may produce an insanity which is the result of a premature menopause. Although these cases are of extreme interest to every gynecologist, they cannot be considered as complications to operation, and consequently will not be treated here, and the term will be applied only to the first class.

Following our 7000 gynecologic operations there have been twenty cases of insanity which developed before the patients left the hospital. In most of them the mental symptoms developed within the first two weeks, four showing signs of insanity immediately after operation. The time after the operation at which the others became insane varied from seven days to five weeks. Dent gives the time to be from two days to eight weeks.

The **causes** of post-operative insanity may be divided into the predisposing and the exciting. "The essential prerequisite for its development must be in all cases a neurotic organization predisposed either from hereditary taint or from acquired nervous weakness to take on diseased action in consequence of any actively disturbing influence."¹ The majority of women in whom insanity develops subsequent to operation give a history of previous nervousness and hysteria, and in many cases the operation is performed for the relief of symptoms due to this nervous condition.

The exciting causes are: excitement and apprehension prior to operation, the prolonged use of the anesthetic, and the subsequent nausea and vomiting, shock and weakness, loss of blood, nephritis or some functional disturbance of the kidneys, infection, autointoxication from the intestinal canal, and the action of certain drugs. In our cases the excitement, etc., prior to operation seemed to be the most important factor. In at least nine of the cases the operation was simple, the time of anesthesia short, there was no evidence of infection, there was no excessive hemorrhage, no shock, and no poisoning by drugs. The operations were as follows: Hysterosalpingo-oöphorectomy, 4 cases; hysterectomy for carcinoma, 3 cases; curetment for carcinoma, 2 cases; perineorrhaphy and suspension of the uterus, trachelorrhaphy, fixation of the kidney, removal of a vesical calculus, and excision of a syphilitic stricture of the rectum, one case each. In one case of hysteromyomectomy there was an intimate connection between the development of the insanity and of nephritis, the appearance of albuminuria and casts in the urine occurring with that of the mental symptoms and likewise disappearing with them.

¹ Hurd, H. M.: "Post-operative Insanities and Undetected Tendencies to Mental Disease," *Am. Jour. Obst.*, N. Y., 1899, xxxix, 331.

Iodoform is said to be the cause of post-operative insanity quite frequently. Atropin, eserine, salicylic acid, and the salicylates are also supposed to be causes, while foreign bodies, as drainage-tubes, etc., have apparently been the cause of persistent insanity.

The **prognosis**, according to most authorities, is fairly good, rather more than half of the cases recovering entirely. A considerable proportion recover within a few weeks, and most of the others which have a favorable termination within six months.

There is no especial form of mental disturbance to which the term post-operative insanity can be applied. Most cases belong to the type known as confusional insanity. In this class of cases insomnia, headache, irritability, and restlessness may precede the attack. During the attack the patients are generally very talkative, frequently repeating in succession a number of words which rhyme. They may have hallucinations or illusions, and are, at times, extremely restless, continually trying to get out of bed and to tear off their bandages or clothing. At other times they are apathetic, quiet, pay little attention to what is going on around them, and in some instances they sink into a stupor. The most prominent feature is the cloudy mental condition of the patient, who recognizes neither her friends nor surroundings. There is generally a temperature of 100° to 101° F., the tongue is coated, there is anorexia, or there may be refusal of food.

Acute mania, melancholia, and other forms of insanity may develop after operation.

The **treatment** of the condition properly belongs to the alienist. Until the danger of tearing open the wound is past and the patient can be safely conveyed to a suitable institution, she should be confined to bed, forcible means being used, if necessary. Due attention should be paid to the proper feeding. Nourishing, easily digested food should be given in liberal quantities, and, if resistance to its proper administration be encountered, enforced feeding should be resorted to. To induce rest the bromids, either alone or combined with chloral, are recommended. Hyoscyamus is also recommended. Warm baths or sponges are soothing and tend to produce sleep. In cases where there are evidences of kidney disease, diuretics, diaphoretics, and salines are indicated. The proper regulation of the bowels should be attended to and strict rules with regard to cleanliness enforced. The latter is very necessary, as with the involuntary passage of urine and feces bed-sores and local infections are apt to result.

The **advisability of operating upon patients for the effect of mental impression** is constantly coming forward. There is a prevalent idea among the laity and many of the medical profession that where a woman complains of vague and indefinite pains, nervousness, etc., the origin of the symptoms is in the genitalia, and many patients have the idea fixed firmly in their minds that an operation is necessary to cure them. These cases are rarely benefited by an operation and are usually made worse. The most difficult cases to deal with are those who have slight abnormalities and in whom it is possible that the symptoms are indeed due to this condition.

Examples of such cases are slight retroversions of the uterus in nulliparous women, certain forms of dysmenorrhea, movable kidney, etc. In all such cases the tendencies to mental disease should be carefully considered, and the rule of the surgeon should be to operate only in those cases where actual disease is present which there is a probability of curing by operation. (For a further consideration of this subject see Vol. I, pp. 314-320.)

PROLAPSE OF THE FALLOPIAN TUBE.

After vaginal hysterectomy or other operations where the vault of the vagina is freely opened and the tubes are not removed, the fimbriated ends occasionally fall down into the opening and become fixed in this position by adhesions and scar tissue. The condition may give rise to a mistake in diagnosis in cases of hysterectomy for carcinoma of the uterus, the fimbriæ being mistaken for a recurrence of the disease. The end of the tube also resembles very closely fresh granulation tissue. In either case the mistake might subject the patient to unnecessary alarm and treatment. A histologic examination of the tissue is necessary to make a positive diagnosis. Two cases of the kind have occurred in the Johns Hopkins Hospital. Usually, treatment is not necessary.

CHAPTER XXVII.

CESAREAN SECTION AND PORRO-CESAREAN SECTION.

By J. F. W. Ross, M.D.

By Cesarean section is meant the removal of the fetus from the mother by making an opening through the abdominal or vaginal walls and an incision into the uterus.

Porro-Cesarean section means the abdominal removal of the body of the pregnant uterus—the pregnancy being near or at term. This title has been made to apply to amputation of the uterus. There is no term, as yet coined, to apply to the total removal of the pregnant uterus.

If Greig Smith's definition, "that Cesarean section means the removal of the child from the mother who fails to deliver it," is adopted, it must necessarily include ectopic gestation.

History.—Long before the operation had been performed on the living woman it had been recommended in cases in which women died undelivered. Many celebrated men are said to have been brought into the world in this way.

The *lex regis* of Numa Pompilius distinctly ordered that no woman with child should be interred until after the abdominal cavity had been opened. This law still exists in the Roman Church. The original idea of it was to rescue the child in order that it might be baptized before life became extinct.

The precise period at which the operation of Cesarean section was first performed on the living woman remains undetermined. In 1581 Roussett published a monograph upon the subject. About this time it appears that the operation was very successfully performed, and many operators were emboldened to perform it without the proper indications. We are told that it became almost as common as blood-letting in Italy. Soon a reaction set in and the operation fell into disrepute. The results were not satisfactory and the procedure was looked upon with anything but favor. After a time fresh proofs were brought forward to show that it might be successful if performed by skilled hands. No doubt the advantages and disadvantages were greatly exaggerated during the whole of the seventeenth century. The maternal mortality was so great that the operation was condemned until, in 1876, Porro introduced his operation of Cesarean section accompanied by amputation of the uterus. Statistics showed that this was a very successful procedure, and it made a much more favorable showing than the operation of Cesarean section in which the uterus was left behind.

Sänger, of Leipzig, now insisted that the suturing of the uterine wall was essential, and after careful suturing was carried out the results were much better.

Isolated cases are reported in which the operation was performed carelessly without asepsis or anesthetics; some were successful. Harris tells us that in Ohio a patient made a good recovery after a Cesarean section had been performed by the doctor in charge with only the assistance of two women and under such conditions.¹

Probably the earliest operation performed upon the living woman was done about the year 1500 by Jakob Nufer, in the Canton of Thurgau. He was a gelder and a spayer of cattle. His wife had been in labor for some time, and after those in attendance considered the case hopeless he opened her abdomen and delivered the child. Strange to say, she recovered from the operation and gave birth to several other children at later periods. The truth of this story is doubted.

According to some authors the operation has been successfully performed by midwives.²

Women have performed Cesarean section upon themselves. The operation has been accidentally performed upon women far advanced in pregnancy by rips from the horns of cattle. Harris³ says that six women in one hundred and nineteen years performed Cesarean section upon themselves and that of eleven women ripped open by horned animals, eight escaped death.⁴

Many of the uncivilized nations, the inhabitants of Uganda and Central Africa, are known to have performed Cesarean section.⁵ Such operations are also known to have resulted favorably to both mother and child. Palm wine was the fluid used for washing the abdomen of the patient and the hands of the operator. The abdominal wound was closed by long pins just as it was closed by the older operators among civilized nations. The sutures were placed over the pins in the figure-of-8 as in the operation for harelip.

Godson states that for over one hundred years the operation was performed without a single success in Vienna, and that the same was true in Paris. Chiaria, of Milan, is credited with sixty-two operations and three recoveries.

The results obtained in former times are now of historical importance only, and the operation has taken its place among the most successful of surgical procedures. American surgeons have done much to place the operation in this position.

Conditions for Which the Operation May be Done.—There are five operations which may be considered. They are Cesarean section, Porro-Cesarean section, induction of premature labor, symphysiotomy, and craniotomy. Each has its indications and each has its contraindications.

¹ Richmond, John L.: "History of a Successful Case of Cæsarean Operation," *Western Jour. Med. and Phys. Sciences*, 1830, vol. iii, p. 485.

² "Edinburgh Essays," vol. v, p. 439. Burroughs, J. J.: "Cæsarean Section Post-mortem—Successful Delivery of a Living Fetus," *New Orleans Med. and Surg. Jour.*, vol. xi, p. 427. Dubrac, F.: "Etude uncas de responsabilité médicale," *Annales D' Hygiene Publiques*, Tome ix, 3s. 1883, p. 108.

³ Harris, Robert P.: "Six Self-inflicted Cæsarean Operations with Recovery in Five Cases," *Amer. Jour. Med. Sci.*, Feb., 1888, p. 150.

⁴ Harris, Robert P.: "Cattle-horn Lacerations of the Abdomen and Uterus in Pregnant Women," *Amer. Jour. Obst.*, July, 1887, vol. xx, p. 673, and pp. 1033-36.

⁵ Felkin, Robert W.: "Notes on Labor in Central Africa," *Edinburgh Med. Jour.*, April, 1884, pp. 922-930.

Cesarean section must be considered in two senses: first, when it is the operation of election; and, secondly, when the indications for it are absolute. Great narrowing of the pelvis is an absolute indication for the performance of either the Cesarean or Porro-Cesarean section. (Fig. 406.) In all cases in which the narrowing of the pelvis exists it should be discovered before labor. An examination of the patient would convince the physician that delivery in the ordinary way would be impossible or extremely difficult. He should govern himself accordingly and have the patient so placed that she would be most favorably situated whatever method of procedure might be finally adopted to deliver her.

An easy method of remembering pelvic measurements is to recall that there is a difference of an inch between the conjugate, or the antero-posterior diameter, and the transverse diameter, and that for all practical purposes the conjugate or antero-posterior is $4\frac{1}{2}$ inches and the transverse $5\frac{1}{2}$. We may say, therefore, that a measurement of $3\frac{1}{2}$ inches (8.5 cm.) in the conjugate is sure to offer an obstacle that may result unfavorably to both mother and child. If the child's head is so much diminished in size as to offset the narrowing of the pelvic measurements, delivery may, perhaps, be accomplished without much difficulty. This variation of the normal conditions presents features of much interest and demonstrates practically that pelvimetry alone, in many cases, is of very little use at the bedside—it must be valued in connection with the size of the child's head.

It seems rather absurd to endeavor to settle these questions by mere measurement of inches or centimeters, because it is impossible for us to estimate the variations that may occur in both the size and the consistency of the fetal head. When the indications for Cesarean section are absolute (5 to 6 cm.), it is unnecessary to discuss symphysiotomy or craniotomy, and scarcely wise to discuss the induction of premature labor. Symphysiotomy will not give room enough through which to deliver a living child; craniotomy cannot for a moment be considered as the child is living, for today this operation should not be performed upon the living child. If the patient is exhausted by long labor, the maternal mortality after



FIG. 406.—ACHONDROPLASTIC DWARF. CESAREAN SECTION; RECOVERY (J. F. W. ROSE).

Cesarean section is certainly no greater than that after craniotomy, and in the one case the child can be saved alive and in the other its life is destroyed.

If the patient has a very much contracted pelvis, with a conjugate, say, of three inches (7.5 cm.), and is anxious to bear a living child, the question arises whether it is possible to deliver her prematurely and save the child. The premature condition of the fetus endangers its life, though it may render its delivery possible. Under such circumstances it is very difficult to choose the right time at which to induce labor. If induced at too early a period, the life of the fetus is still further endangered; if induced at too late a period, a difficult delivery must necessarily endanger its life. By modern Cesarean section the life of the fetus will certainly be better insured, while the danger to the mother should not be much, if at all, increased.

Such results as those recorded by Reynolds,¹ of cases of Cesarean section known to him personally, in which there were thirty recoveries in thirty cases, must encourage us to perform this operation more frequently than we have been accustomed to do in the past. We must remember, however, that to obtain such results, it is of vital importance that the operation should be undertaken early, and that the operator must be thoroughly familiar with every detail. Cesarean section must not be a last surgical resource to effect the delivery of the mother. It must be a conservative procedure to save the lives of both mother and child.

If we look carefully into the question of the mortality to the mother from Cesarean section at the present time and under the most favorable circumstances, performed by experienced operators, we must be convinced that the mortality is not much higher than that from oöphorectomy, while the mortality to the children is *nil*. The mortality to the mother from severe forceps delivery is from 1 to 2 per cent., while the mortality to the children is large, namely, from 25 to 30 per cent.

The modern German statistics, when analyzed, teach the same lessons. To estimate the real value and danger of the operation the women operated upon in good condition must be separated from those already exhausted or septic upon whom emergency operations were done. Olshausen² reports ninety-one cases of Cesarean section for contracted pelvis, with nine deaths. He did sixty-five of these operations himself, and in this series had three deaths—a mortality of 4.6 per cent. The ninety-one operations were upon women admitted seriatim to an obstetrical clinic, and included emergency cases.

Neumann³ records one hundred and seventy Cesarean sections in Schauta's clinic, done for every variety of indication, with a total mortality of fourteen—8 per cent.

¹ Reynolds, Edward: "The Cesarean versus Fetal Mortality." Amer. Jour. of Obst., 1898, vol. xxxvii, No. 6, p. 721, and personal communication.

² Olshausen, R.: "Zur Lehre von Kaiserschnitt," Zentralbl. f. Gynäk., 1, 1906.

³ Neumann, Julius: "Die Sectio Caesarea am der Klinik Schauta," Zentralbl. f. Gynäk., 29, 1905, 913.

Leopold¹ reports one hundred cases, seventy-one of which were Cesarean sections and twenty-nine Porro operations, with a total mortality of ten—10 per cent.

Von Braun-Fernwald² reports seventy-four Cesarean sections from Braun's clinic. There were six maternal deaths, or 8.1 per cent. mortality. He also reports that Zweifel has had seventy-six conservative Cesarean sections with one death. The patient that died was septic when operated upon and, therefore, should be excluded in estimating the mortality of the elective Cesarean sections. Hence, in Zweifel's hands, the operation has been without mortality.

An analysis of Braun's cases shows that five of the deaths were due to infection before operation or to delay in operating or to complicating diseases, so that the patients were exhausted or in bad condition. Norris,³ quoting Pinard's statement at the International Congress at Amsterdam in 1897, says: "A résumé of the statistics of Leopold, Olshausen, and Zweifel shows a mortality of 5.8 per cent. for the conservative Cesarean section, and of 3.7 per cent. for the Porro operation."

When the indications are not absolute we are placed in a very difficult position. The question we have then to answer is, What will take place in a case in which the pelvic measurements are diminished? If the woman has had repeated difficult labors, with the death of the child in each case, Cesarean section offers a ready and safe means of delivering a living child. The patient can make her own choice after the matter has been put fairly before her. The question can be discussed with her before labor. She must be told everything that is favorable, and that the chances are that she will have a living child. Also none of the risks should be hidden from her. She should not be called upon to judge as to the relative merits of the various operations, but should consent to what appears to be, in the judgment of her attending physician or physicians, the wisest course of procedure. Reynolds says that when a practitioner is consulted by a patient in whom a previous labor has resulted in the delivery of a stillborn child by high forceps or version, performed for simple delay, that is, in the presence of obstetric emergencies, the pelvis should be measured and the question of the performance of Cesarean section should be settled in advance of labor upon the rules laid down.⁴

One would not feel so much in favor of Cesarean section when only *one* labor had resulted in the death of the fetus, as when there had been *two* such labors. We all know that a primiparous woman may have a difficult forceps delivery, may lose her child, and may subsequently bear children after labors that are neither difficult nor instrumental. The characteristics of the fetal head do not appear to be different in many of these cases, so that there must be some other element that

¹ Cörner: "50 Kaiserschnitte wegen Beckenge." Arbeiten a. d. Kgl. Frauenklinik zu Dresden, Bd. i, 1893; Leopold u. Naake: "Ueber 100 Sectiones-Caesareae," Archiv. f. Gynäk., Bd. lvi, Hft. 1, p. 1.

² Von Braun-Fernwald, Richard: "Ueber die in den Letzten 10 Jahren ausgeführten Sectiones Caesareae," Arch. f. Gynäk., lix, 320.

³ Norris, Richard C.: "Progressive Medicine," Sept., 1900, 381.

⁴ Reynolds, Edward: "The Cesarean versus Fetal Mortality," Amer. Jour. of Obst., 1898, vol. xxxvii, No. 6, p. 729.

facilitates a second delivery; the pelvis has become more roomy. I am afraid that the advocate of Cesarean section, under such circumstances, will frequently be discredited by the fortunate and unexpected delivery of these women in the ordinary way. For this reason, it is wise to place such women in a suitable environment, and only resort to Cesarean section after a test of the natural forces of labor. If, on the other hand, two or three labors have resulted in the delivery of stillborn children by high forceps or version performed for simple delay, we can then rest assured that the obstruction continues to be equally great and that there is no chance for the delivery of a living child on a future occasion, unless by the induction of premature labor, symphysiotomy, or Cesarean section.

It is a well-known fact that many infants are seriously injured for life as a consequence of a severe delivery *per vias naturalis*. Even though they are delivered by symphysiotomy, these infants may be damaged.

In considering the operation of symphysiotomy, the amount of room to be gained and the subsequent convalescence of the patient must be taken into careful consideration. A patient will regain health and strength more rapidly, perhaps, after the performance of a Cesarean section than after the operation of symphysiotomy. A considerable weakness of the symphysis may exist for some time. A comparison of the two operations must, therefore, be instituted in order that we may arrive at a correct conclusion. In the hands of a skilled surgeon the one operation is almost as difficult as the other, though, perhaps, the operation of symphysiotomy requires less preliminary preparation. One very important point to be borne in mind is the fact that it is difficult to say that the amount of room gained by the performance of symphysiotomy will be ample to permit of the delivery of the fetus without injury to the soft parts of the mother.

Zinke¹ mentions one case in which it was necessary to perform Cesarean section after an effort had been made to deliver the woman by symphysiotomy. This shows the difficulty to be met with in accurately determining whether the increased room will permit of the passage of the child or not. The same author also says that in several instances Cesarean section had to be substituted for symphysiotomy on account of the ossification of the joint. This difficulty may be overcome by using a chain-saw.

With a conjugate diameter of $3\frac{1}{4}$ inches, one mother out of thirteen died, and with a conjugate of $2\frac{7}{8}$ inches, four out of fifteen died after the performance of symphysiotomy. Of all children delivered through a conjugate of $3\frac{1}{4}$ inches, four out of thirteen died, and through a conjugate of $2\frac{7}{8}$ inches, two out of fifteen died. So that we see that even with a conjugate of $3\frac{1}{4}$ inches, modern Cesarean section ought to give a lower fetal mortality than symphysiotomy. As with Cesarean section so with symphysiotomy, the operation is frequently not done until the patient is in *articulo mortis*. The high maternal mortality cannot be laid at the door of the operation itself. But the infant mortality from the operations also

¹ Zinke, E. Gustav: "Symphysiotomy vs. Embryotomy upon the Living," *Ohio Med. Jour.*, vol. vi, 1895, p. 73.

remains high. With Cesarean section the infant mortality is likely to be reduced.

Reynolds concludes that he would use symphysiotomy in cases in which we have a moderately contracted pelvis in a woman not previously healthy, and in cases in which the mother is exhausted by long labor. In the latter, if symphysiotomy fails to give sufficient room, we still have another resource, but the chances are that in the efforts to deliver the woman the life of the child will be sacrificed. If this occurs, we might just as well have performed craniotomy at the outset. But why allow the woman to arrive at this condition? It is easy to sit in one's arm-chair and argue; it is more difficult to act for the best at the bedside.

The patient is in labor, the cervix dilates, the pelvic measurements show a not very great diminution from the normal; the child does not come down, and we naturally proceed to assist in the delivery by a forceps operation. When the forceps are placed it is necessary that they be pulled down, and unless they are pulled upon vigorously, we might better have left them unapplied. We are now enabled to determine the compressibility of the head, and from a slight traction we proceed to apply more force. The forceps begins to slip and perspiration to bathe the operator. The progress may be very slow. Finally, when the forceps fail to deliver a consultation is called for. Unless the consultant has every confidence in the doctor in charge, he may desire to apply the forceps himself and make his own attempt to deliver the patient. When he has done so the patient is, in all probability, much exhausted, the soft parts bruised, and the fetus dead. If the operator is certain that the fetus is dead, the head is now perforated and the child delivered, and he feels thankful that he has succeeded in saving the life of the mother.

When we look back over such a case we naturally ask ourselves, At what point should pelvic delivery have ceased and Cesarean section (abdominal) have begun? It is easy for us to review such a case and to criticize, but the obstetrician who enters a gentleman's house, and, without making an effort to deliver his wife, tells him that she must be delivered by Cesarean section, is liable to be discharged unless he is fortified by a very considerable reputation in this particular branch. Pelvic delivery is looked upon as a natural procedure, Cesarean section as an unnatural one. When it is rendered a safe method of delivery and the woman is able to escape the pangs of labor, many of the difficulties that now surround the attending obstetrician will disappear.

But no matter how much we teach or how much we argue, cases such as the above will continue to be treated in exactly the same manner by the very best obstetricians. We must remember that there is the danger that the pendulum will swing too far, and that Cesarean section may be undertaken in cases in which a forceps delivery, if attempted, could be carried to a successful issue. Unless the patient is practically moribund, Cesarean section should not be undertaken unless the most thorough preparations have been instituted for its performance and proper assistance has been secured.

The operation has been performed with very satisfactory results after the death

of the mother. Villeneuve says that in five such cases the fetus remained *in utero* for from five minutes to half an hour after the mother's death. The fetus is not very likely to survive if left longer than half an hour *in utero*. It has been claimed, however, that it has survived much longer. It is a well-known fact that children have been put aside apparently dead, and have suddenly astonished the attendants by crying out, so that it must be very difficult for any one to say that a child *in utero*

is actually dead before it is removed. It is unpleasant to think that the body of the mother should be the coffin of the child. It is always better that the woman should be delivered even after death.

Those who have performed

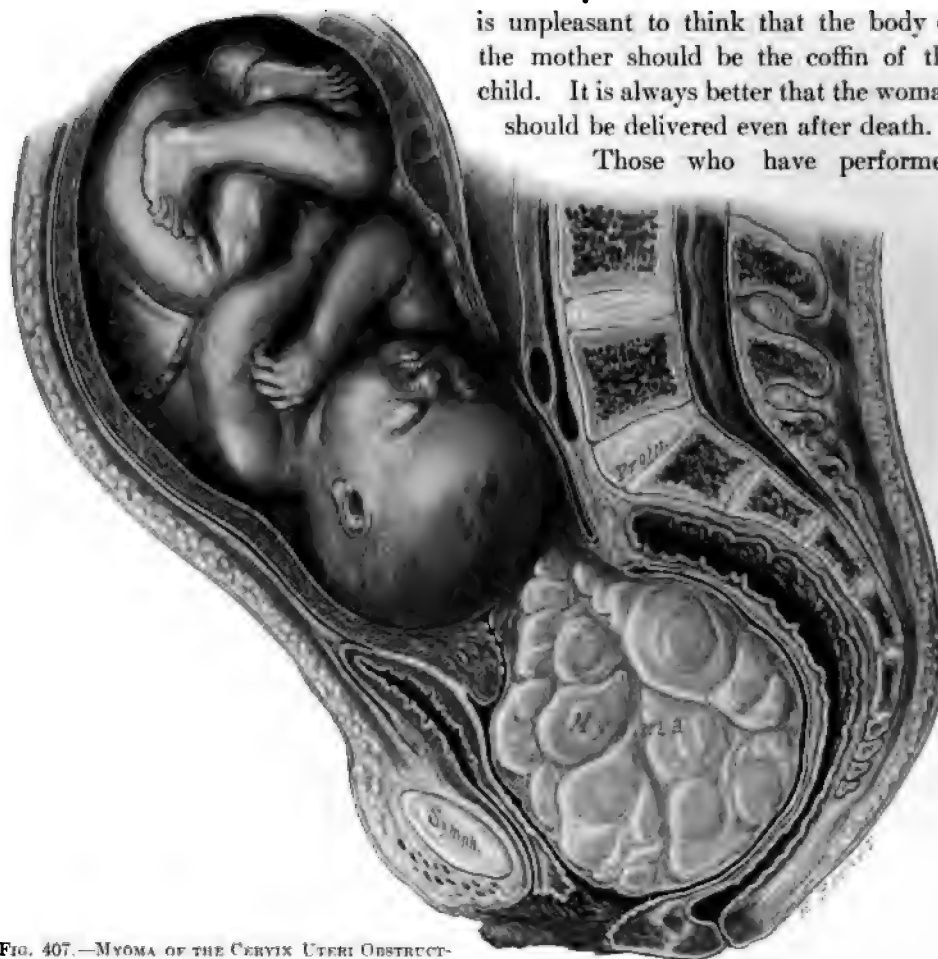


FIG. 407.—MYOMA OF THE CERVIX UTERI OBSTRUCTING DELIVERY.

Cesarean section will be most reluctant to consent to the induction of premature labor, or to the performance of the operations of symphysiotomy or craniotomy. Our first duty is always to the mother when the question of operation is being considered. The chances of success after Cesarean section are greater if the operation is performed before or shortly after the onset of labor.

It has been stated that the poor results among surgeons are due to lack of knowledge of the pelvic measurements on the part of the attending physicians. This

may be true to a certain extent, but all who have experience with pelvic measurements know that it is difficult to obtain measurements made by different obstetricians that will coincide.

Cases are met with in which one feels satisfied after examination that there will be great difficulty in labor; measurements are made to confirm this view; the patients drift away, and for some unknown reason are delivered with but little difficulty. If the pelvic brim were exactly circular, or oval, and the fetal head were always equally compressible, we could then rely upon pelvic measurements.



FIG. 408.—OVARIAN CYST OBSTRUCTING DELIVERY.

But as the pelvic brim is irregularly shaped, and as the fetal head presents varying degrees of compressibility, pelvic measurements will often be uncertain guides.

The causes of dystocia are pelvic deformities and obstruction of the pelvis by tumors occurring in the ovary (Fig. 408), the cervix uteri (Fig. 407), the vaginal tissues or the pelvic bones (Fig. 409). Dystocia has followed the operation of ventrofixation in numerous cases. The pelvic deformities usually enumerated are rachitic deformity, kyphotic pelvis, oblique pelvis, dwarf pelvis, coxalgic pelvis, and anchylosed pelvis.

Noble¹ relates two cases, one delivered by version and the other by Porro-Cesarean operation, in which the dystocia was produced by ventrofixation.

Inflammatory exudate blocking the pelvis has also caused such serious dystocia that Cesarean section was performed. Noble relates a case of this kind. The pelvis was blocked with inflammatory exudate forming a tumor. To deliver the child, Cesarean section was performed. Subsequent sloughing took place and a uterine fistula opening on the front of the abdomen was established. This fistula never healed soundly. The patient again became pregnant and consulted Noble about the thirty-third week of pregnancy. The membranes had ruptured and the waters were coming away through the ventral fistula and the fistulous opening was

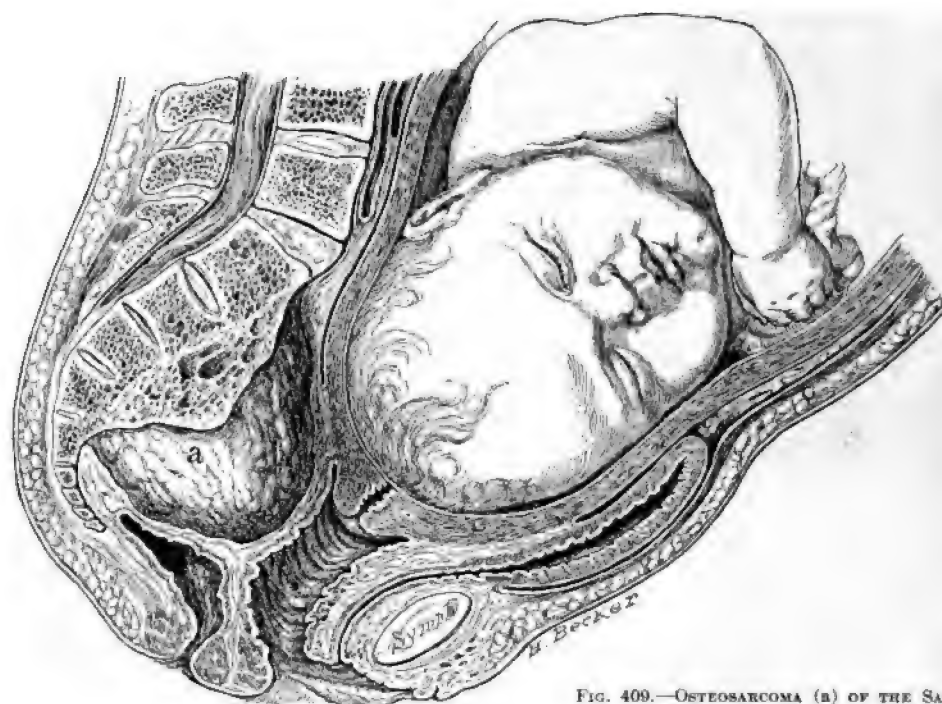


FIG. 409.—OSTEOSARCOMA (a) OF THE SACRUM OBSTRUCTING DELIVERY.

dilating under the influence of the feeble uterine pains. The cervix was but slightly dilated and in the center of a mass of scar tissue. The fetus was small and immature. After Cesarean section the hemorrhage could not be controlled in the usual way on account of the intra-abdominal fixation of the uterus. It was, therefore, inverted through the wound of the operation so that the assistant could grasp the lower uterine segment while the secundines were peeled off. Some of the deep stitches were passed through both uterine and abdominal walls. The patient recovered and the fistula has not reformed.

¹ Noble, Charles P.: "A Clinical Report on the Course of Pregnancy and Labor as Influenced by Suspensio Uteri," Amer. Gynec. and Obst. Jour., Nov., 1896, p. 543.

In cases in which fibroid tumor of the cervix obstructs the pelvis a spontaneous delivery sometimes occurs in a very peculiar manner. The tumor is flattened and compressed and under the action of the longitudinal fibers of the uterus it slips up above the pelvic brim, the fetus comes down, and delivery is effected without difficulty. To the observer it would appear that such a delivery would be impossible. Impacted tumors of the lower uterine segment or of the ovaries that cannot be replaced under anesthesia require Cesarean section. Injuries that have produced contraction may necessitate the performance of Cesarean section. In a recent case the writer performed Cesarean section owing to the presence of this condition. As a girl the patient had slipped upon an iron hoop when going down-stairs, cutting the soft structures about the perineum and producing a serious injury. A doctor was sent for, and when he attempted to examine her, she jumped out of a first-story window and fell astride of a wire clothes-line, cutting through the sphincter ani and all the soft tissues down to the coccyx behind and the pubic bone in front. As a woman she became pregnant, and shortly after labor set in, Cesarean section was performed and mother and child survived. (Case reported by G. E. Smith, of Toronto.)

Time for Operation.—Some authorities operate before labor begins, others wait until it has begun. The latter think that in this way better drainage is secured through the dilated cervix and that the risk of hemorrhage is not so great. Drainage, however, can be easily obtained by dilating the cervix previous to, or at the time of operation, and passing a strip of gauze down through it into the vagina; hemorrhage may be avoided by inducing uterine contractions by the administration of ergot. Some of these objections are, therefore, easily set aside, and it must be conceded that the best period to select is either before labor has begun or shortly thereafter, before there is any exhaustion of the mother.

Technic.—The general principles involved in all abdominal operations apply to Cesarean section, whether the vaginal or abdominal route is selected. Dührssen has taught us how to perform the operation through the vagina; Sänger, through the anterior abdominal wall. It should always be performed, if possible, in a well-appointed operating room. If this is not feasible, and it is necessary to use a room in a private house, every attention should be given to its preparation in order to secure cleanliness and asepsis. (See chapter on Gynecological Technic, Chap. I, Vol. I.) When the operation is performed upon a woman already dead or in *articulo mortis*, it may be done upon the patient's bed, but even then, if feasible, it is better to transfer her to a suitable table. Patients apparently moribund may survive if given the chance.

The preparation of the patient for a Cesarean section is the same as that for all abdominal operations, with the exception that a well-trained assistant should be at hand to take charge of the infant as soon as it is delivered. This assistant must be responsible for the new-born child, and resuscitate it by means of artificial respiration, etc., if necessary.

The instruments required are as follows:

Scalpel.
 Strong scissors, straight and angular.
 One dozen or more hemostatic forceps, carefully counted and recorded.
 One pair of midwifery forceps.
 Needle-holder.
 Needles.
 Silk and silkworm-gut for sutures.
 Hypodermic syringe, with ergotin.
 Irrigator.
 Piece of elastic cord or tubing, three feet long and in good condition.
 Thermocautery.
 Catheter.
 Pair of retractors.
 Pedicle needle.
 Curved trocar.
 Vaginal speculum (Sims-Edebohls).
 Vaginal retractors.
 Bladder sound.
 Clover's crutch or leg supports.

Incision.—*Abdominal Route.*—The abdominal wall is cut into; the skin and fat being severed with one sweep of the knife. The sheath of the rectus muscle is reached and opened and its posterior layer cut through, or the incision may be carried through the linea alba. The preperitoneal fat bulges into the wound and can be raised by the thumb and index-finger of the left hand. It is then held up by the forceps and cut into with the scalpel. The peritoneum will now be seen, and this is raised and cut through, care being taken to draw it well away from the abdominal cavity so that the underlying intestines are not injured. The part of the incision by which the abdomen is opened should be higher than the customary celiotomy incision, the umbilicus being at its upper third, and the incision about six inches long.

After the abdominal cavity has been entered it is easy to locate the bladder, and the incision can be increased downward without endangering that organ. Sufficient room must be obtained for the delivery of the child.

Three courses are now open to the operator. It has been recommended that the liquor amnii be allowed to escape through the cervix in order that the size of the uterus may be reduced. The loss of the liquor amnii cannot, in any way, affect the chances of the fetus, and the uterus will contract just as well as if the amniotic fluids were extracted through the new opening made into the fundus. In this way the uterus may be reduced very much in size, and can, therefore, be removed from the abdominal cavity through a much smaller incision.

Another method of procedure is to withdraw the uterus from the abdominal

cavity without puncturing the membranes from below or opening into them or puncturing them from above.

The third method of procedure is to open the uterine cavity while still *in situ* within the abdomen. If it has been decided that the uterus should be opened before its removal from the abdominal cavity, precautions must be taken to prevent the escape of the liquor amnii among the intestines. Sponges must be placed around the uterus and the abdominal walls should then be kept in as close apposition to the anterior surface of the uterine body as possible.

The first method is, perhaps, the ideal one. The organ can be better controlled when outside the abdominal cavity and there is less danger of contamination of the peritoneum by the escape of intrauterine contents. The organ can also be more readily controlled with the fingers of the assistant placed over each uterine artery. After it has been removed from the abdominal cavity it is well to place two or three sutures with which to approximate the upper portion of the opening



FIG. 410.—ABDOMEN OPENED AND PREGNANT UTERUS SEEN PRESENTING.

through the abdominal walls. (See Fig. 411.) A large, flat sponge is placed to keep back the intestines; sutures are kept in position by means of the first portion of the surgeon's knot; they need not be completely tied, as they are only temporary, and can be readily undone after the uterus is ready to be replaced in the abdomen.

A sterilized towel is now placed beneath the uterus and another covers its superior and lateral surfaces. If the assistant cannot be relied upon, the operator may feel disposed to place an elastic ligature around the cervix, and, in any event, it is, perhaps, best to do so, but only at the last moment before incising the uterus,

in order that the fetus may not be asphyxiated. The ligature is fastened by a single tie, and the two ends held at right angles to the knot or fastened by a pair of compression forceps.

Many operators have remarked the difficulty with which the fetus is, at times, resuscitated, and it will be interesting to watch the favorable influence upon the fetal mortality of the improved methods of operating. The encircling the uterus with an elastic ligature probably increases infant mortality.

The contraction of the uterus assists in preventing hemorrhage. The handling of the uterus and its exposure to the air will excite it to contract, and this may prove to be a decided advantage. We need not dread any increased risk from removal



FIG. 411.—ABDOMEN OPENED, UTERUS LIFTED OUT, TEMPORARY SUTURES PLACED.
This drawing shows the ease with which the vessels can be controlled.

of the uterus from the abdominal cavity. Those who have pursued this practice are satisfied that it does not increase the shock.

An incision is now made into the uterine wall by means of the scalpel; or if the operator chooses to use scissors, he may do so.

If the amniotic fluids have escaped from below, the membranes will not bulge into the incision unless the placenta is in the way. The membranes may be tapped with an ovariectomy trocar and the amniotic fluids can in this way be conveyed to a vessel held by one of the assistants. The danger of escape of fluid into the abdominal cavity is thus largely minimized.

If the placenta is on the anterior wall, an incision into the uterus brings the opera-

tor face to face with all the features of placenta prævia. No attempt should be made to strip off the placenta from the sinuses, but it should be rapidly torn through and the fetus reached. The fetal parts should be seized and a quick delivery effected. When making an incision into the uterus, it should be made long enough to permit of the ready extraction of the fetus without tearing the uterine wall. When the body of the child is drawn into the wound the pressure assists in preventing any further loss of blood. It is here that presence of mind and an exact knowledge of what should be done are of great service to the patient. A rapid operation means a minimum loss of blood. All surgeons who have performed this operation have been struck with this fact. It is a good thing to know exactly what to do and how to do it. Armed with this knowledge, we need have no fear in dealing with the placenta.

The hand of the operator is passed rapidly into the uterine cavity, one foot or the two feet are grasped, and the buttocks and body of the child are rapidly delivered, and perhaps the head may come away without difficulty. If an arm is grasped it should be dropped and a foot sought for. If delivery is accomplished by drawing on an arm, the uterine opening must be larger than for a delivery by one or both feet.

It occasionally happens that the head has become impacted at the pelvic brim. As a rule, a little traction will dislodge it, but if not, the hand of the third assistant can be passed into the vagina and the head pushed up so that it may be easily delivered from above. The uterine muscular fiber at the incision may contract about the child's neck; this difficulty can be easily overcome by nimble fingers, provided the uterine incision is large enough to permit extraction. A pair of midwifery forceps should always be at hand, but will scarcely ever be needed. The delivery of the child should be rapid in order that its life may be saved. Clamps should be applied to the cord in two places and the cord cut through between them. The fetus is then handed to the assistant, and he must be expert enough to perform artificial respiration if it is required.

The placenta has now to be dealt with. The operator should instruct his assistant either to tighten the elastic ligature or to put compression on the uterine arteries with his fingers. The life of the fetus is not endangered by this procedure, as it has been delivered. If the elastic compression is applied too early, it is likely to paralyze the uterus and prevent proper uterine contraction. If the uterus contracts well there need be no hesitation about removing the placenta; the more it bleeds, the more rapidly should its removal be accomplished. The hand should be passed in and the placenta loosened by a sweep and immediately removed. After its removal we have a much better opportunity of controlling hemorrhage than while it is partly *in situ*. It may not be necessary to grasp any of the vessels nor yet to grasp the fundus, provided contraction takes place and the delivery is rapidly accomplished.

There will now be some oozing from the uterine incision. This can be controlled by the approximation sutures. For this purpose silk is usually used in preference

to catgut. The needles employed should not have too great a cutting surface and they should not be larger than is necessary to convey a sufficiently strong thread. The deep sutures should be placed at intervals of about a quarter of an inch; they should not be placed close enough together to produce complete anemia of the wound. The ends of thread should be cut close to the knot. Care must be taken that the sutures do not perforate the mucous membrane of the uterus. They must be tied firmly in order that the approximation may be complete, but not firmly enough to produce a dangerous amount of constriction. If the tissues are too greatly constricted they lose their vitality. After the sutures have been brought together, oozing from the surface of the wound may still be noticed.

It is now wise to apply the mattress suture, approximate carefully the serous covering of the uterus, bury the deep sutures, add additional protection against sepsis, and prevent further oozing of blood. A needle is passed through the peritoneum at a little distance from the edge of the wound and carried across the wound. It is then passed through the serous coat on the opposite side of the wound and carried parallel to the cut; then brought back over the incision and at right angles to it, to pierce the peritoneal coat in the same manner as in the first part of the stitch. In this way a rectangular stitch is placed with one side of the rectangle wanting; this side is completed by tying the two free ends of the suture. This stitch when used upon the intestines is water-tight. By means of it the serous coat on one side of the incision is brought into accurate contact with that on the other side.

The surface is now washed off with sterilized water or normal salt solution, the towels are removed from about the uterus, the temporary sutures placed in the abdominal wall are loosened and the ends grasped by forceps on either side to prevent their accidental removal. Gauze sponges placed in the abdominal cavity are removed, the cul-de-sac of Douglas is cleansed, and the uterus is dropped back into the abdominal cavity. The vesical pouch is cleansed and the abdominal sutures are then placed in position. Those who prefer the tier suture will suture in tiers; those who prefer the *en masse* suture will suture *en masse*.

Once more the incision in the uterus is inspected to see that the hemorrhage has ceased. The omentum may be pulled down, but it does not remain long in front of the uterus. It soon draws up above the fundus. It has been recommended that the omentum should be pushed into the cul-de-sac of Douglas to permit of adhesions between the uterus and the anterior abdominal wall. It is unnecessary to do this, as the uterus is soon free of omentum as above described.

The usual dressing is now applied to the wound, and this, in turn, is covered by a pad of sterilized absorbent cotton. The dressing is then kept in place by means of adhesive strapping and a binder.

The patient should now be placed in a bed warmed for her reception. She should be stimulated by the application of heat. Pain may be allayed by the subcutaneous injection of $\frac{1}{2}$ grain of morphin. Vomiting, as a rule, is not excessive. The administration of chloroform to a pregnant woman does not seem to be fol-

lowed by much vomiting. There must be some chemical antidote in the blood of a pregnant woman which prevents chloroform from producing vomiting. If great thirst is complained of, it may be relieved by means of rectal enemata, or the patient may be allowed to suck ice placed in gauze and dropped in the mouth, the fluid from which is allowed to run into a vessel placed under the patient's cheek. This will be found very refreshing. After a time, fluid is allowed in small quantities. The diet at first consists of milk, beef-tea, and other fluids.

It may be necessary to use the catheter every six hours, but, if the patient can pass urine voluntarily, she should be permitted to do so. If flatus collects and gives rise to colicky intestinal pains, it may be relieved by the administration of an enema, consisting of turpentine and soapsuds, one dram to the pint. The bowels should be moved by the administration of calomel followed by a saline, administered before any marked distention occurs. Purgatives may be given as soon as the stomach will retain them. It is quite unnecessary to wait for four or five days to secure thorough evacuation of the bowels. The sooner they are evacuated, the better the patient will convalesce.

The child may be put to the breast within twenty-four hours after the operation. In some cases the secretion of milk will suddenly disappear, but will reappear two or three days later.

If gauze has been placed down through the cervix, it should be removed in from twenty-four to thirty-six hours. It will be quite unnecessary to repack the uterine cavity.

Vaginal injections must be carefully given if given at all. Bichlorid of mercury solution, 1 : 2000 or 3000, will answer very well if followed by plain water to prevent any irritation of the vaginal mucous membrane. If the patient has no fever, and the lochia has no offensive odor, douches are contraindicated.

The patient should wear an abdominal binder for some months after recovery.

There is sometimes a sharp rise of temperature during the convalescence. The rise of temperature and elevation of pulse may occur within twenty-four to thirty-six hours from the time of the operation. After thorough evacuation of the bowels has been obtained the temperature drops, the pulse becomes less rapid, and convalescence proceeds without further incident. Occasionally sharp pains may be felt over the front of the uterus in the neighborhood of the incision.

There are other features to be considered in connection with this operation. The incision itself has been varied; some contending it should be made in front of the uterus, others behind, and Fritsch employed the transverse incision in the fundus between the cornua. In one instance this was not sufficient to permit of the removal of the fetus until after a vertical incision had been made at right angles to the first.

Cohnstein¹ recommended that the uterus should be turned out of the abdominal cavity and that the opening should then be made on the posterior surface. After the organ has been replaced in the abdomen, drainage is secured by an incision

¹ Cohnstein: "Zur Sectio cæsarea," Centralblatt f. Gynäk., 1881, Bd. v, Nr. 12, S. 289.

through the cul-de-sac of Douglas and the introduction of gauze from the vagina through the opening. He claims that the patient is thus protected should any leakage occur from the uterine incision, and, also, that the anterior abdominal wall can be completely closed while this object is secured. The intestines, under these circumstances, are more out of the way and the general cavity of the peritoneum is not as liable to be invaded by a progressive septic peritonitis as when the anterior incision is used.

The author cannot agree with this opinion, but favors the anterior incision into the uterine wall, an incision that should be vertical, in the median line, reaching from the upper surface of the bladder below, upward as far as may be necessary to permit of easy delivery of the child.

If gauze drainage is placed in the uterine cavity, great care must be taken to see that it can be removed without difficulty. It is not wise to risk much disturbance of the uterus after operation. The gauze must be so coiled that it will run easily through the cervix when pulled upon. It is not necessary to use gauze in the interior of the uterus when a careful suturing of the uterine wall has been carried out. The mattress sutures already spoken of should never be omitted. When they have been properly applied neither gauze drainage of the uterus, nor drainage of any kind of the abdominal cavity, will be indicated, with the single exception mentioned below.

If at the time of the operation the uterus is septic, the fetus dead, and the uterine mucous membrane a greenish tinge, and it is decided not to amputate the organ, the cavity of the uterus should be packed with iodoform gauze, a portion of which is allowed to pass downward through the cervix. The uterine wound should be thoroughly disinfected before it is finally closed by the tightening of the sutures. When the serous membrane is brought carefully together over the surface, we place a barrier on the peritoneal side so that any pus that may form will be discharged into the uterine cavity. It is quite unnecessary, as a matter of routine, to wash the uterine cavity. If it is irrigated, care must be taken not to allow the water to enter the abdominal cavity. When the uterine cavity is thoroughly dried out and packed with iodoform gauze, no irrigation is required.

If the operator has a doubt as to the condition of the uterus he may insure the greater safety of his patient by packing iodoform gauze over the anterior surface of the uterus, to shut off the rest of the peritoneal cavity from this region. If any contamination takes place through the wound in the uterine wall, the gauze protects the patient from a general peritonitis. Gauze packing in front and gauze drainage within the uterine and vaginal cavities may prove of great service in some of these cases. The objection to the packing in front is that it is liable to permit hernia to occur at a later date.

In dealing with the uterine wound we have to contend with the healing process in an organ that is undergoing involution as well as alternate contractions and relaxations. The contractions of the organ are a benefit in preventing leakage into the abdominal cavity, provided we have free drainage through the cervix.

It was found that, in spite of all precautions, the wound in the uterus had a tendency to gape. On this account Kehrer made a transverse incision at the level of the os internum, claiming that such a wound had less disposition to remain open. Sanger, however, taught us to approximate carefully the edges of the wound by means of sutures, and to reinforce this by obtaining union between two flaps of peritoneum. It was claimed that the serous coats united more quickly than the muscular coats and formed a better barrier against the escape of the intrauterine contents. The muscular tissue was resected, and a portion of the peritoneum was thus freed from the muscle beneath. We have learned, however, that this resection of muscular tissue is quite unnecessary. The peritoneum is lax enough without this, and if not it can be easily loosened by passing a scalpel beneath it.

When we see the difficulty encountered in getting accurate union of the uterine wound, we must conclude that the wound should never be *torn*, as has been recommended. It was supposed that this tearing of the wound prevented hemorrhage.

The frequency with which gangrene of the uterine wound is mentioned in post-mortem records bespeaks the prevalence and activity of septic germs.

The danger of a long incision is the subsequent occurrence of hernia, and another operation may be required to relieve this. It is a question whether this contention is correct or not. All abdominal operators know that hernia does occur from small incisions, and that large incisions will heal quite firmly and strongly when properly approximated.

It is my own opinion that in every case in which future pregnancies may take place, and the patient expresses a wish to avoid the same, they should be prevented by an excision, with scissors, between two ligatures, of a small portion of each Fallopian tube.

Statistics.—After such a series of cases as that given by Reynolds, of Boston, it is scarcely necessary to quote statistics at length. They can be made to prove almost anything. There was a time when nearly all the cases of Cesarean section terminated fatally. Each collector of statistics has had his own mortality percentage. For instance, Michaelis stated that 54 per cent. recovered; Kaiser, that 38 per cent. recovered; Mayer, 54 per cent.; Pihan-du Fillhay, 57 per cent.; and Harris, 40 per cent. These statistics are given by Lusk. It is unnecessary to pursue statistics further. What has been true in the past cannot influence either what is true now or in the future.

The statement is well founded that cases in private practice present a lower death-rate than those in hospitals. In private practice the cases that are operated upon are generally in a better state of health, and there may be a slighter degree of deformity. In private practice the chances are that the operation will be performed earlier and under more favorable conditions, or that the patient will be sent to the hospital when local conditions are not favorable for operation.

The mortality in those cases in which operations have been repeated upon the same patient has been lower than in cases in which a single operation has taken

place. The reason for this will probably be found in the fact that the second operation has been elective and has been performed at a favorable time with favorable surroundings.

The statistics compiled by Harris show that the mortality rate is higher in the cities than in the towns, and higher in the towns than in the country. These statistics antedate the present era.

A large majority of the patients die during the first three days. Two cases have been reported in which each patient had been operated upon four times.

In his statistics of Cesarean section, Harris states that in nine cases in which the uterus was not sutured, none recovered. He mentions two cases in which catgut was used, and both died. As a consequence of his investigations he is much in favor of Porro's operation.

DÜHRSSSEN'S VAGINAL CESAREAN SECTION.

The operation as carried out by Dührssen is as follows: The vagina is washed and sterilized, the bladder emptied, and the parts about the vaginal vault exposed by means of retractors. The cervix having been pulled down, an incision is made through the mucous membrane of the vagina, and the bladder pushed up out of the way, as in the first stage of vaginal hysterectomy. Appreciating that the blood-supply reaches the uterus through the uterine arteries on each side, and that the place in which the fewest important vessels will be cut is in the median line in front, Dührssen, after getting the bladder well out of the way, incised with strong scissors the anterior wall of the cervix and the anterior wall of the uterus until a sufficient opening was made to permit of ready delivery of the fetus. He states that he has performed the operation in eight minutes. It is only of service in cases in which it is desirable to empty the uterus rapidly, and is not suitable for cases in which there is any obstruction to delivery in the pelvis. The chief indication for its employment is puerperal eclampsia. The uterine wall may be stitched up with catgut, a gauze drain placed, and a vaginal tamponade made with iodoform gauze. The hemorrhage from the wound in the uterus is but slight so long as it is made in the median line in front.

PORRO-CESAREAN SECTION.

History.—This operation was first recommended by Blundell, of London. Porro's first successful case was performed in May, 1876, although Harris thinks the operation was done in Boston in July, 1868. Spaeth, of Vienna, performed the operation a short time after Porro's first case, and successfully. The patient was a dwarf primipara who had been in labor for several hours. The child was removed by Cesarean section, but the uterus did not contract sufficiently to stop the hemorrhage and the operator decided to remove the organ.

Before the operation was carried out on woman, experiments were made by the

removal of the uterus from bitches. They survived the operation, and the conclusion was arrived at that the uterus could be safely removed after the delivery of the fetus by Cesarean section. Blundell thought that the removal of the uterus would increase the safety of a Cesarean section by removing the organ that was likely to become septic, or likely to leak into the abdominal cavity. Harris, who has made a careful study of these operations, is a very warm advocate of Porro's operation.

Conditions for Which the Operation may be Performed.—Porro-Cesarean operations may be divided into three groups:

First, Cesarean section followed by amputation of the uterus, or the true Porro operation.

Secondly, amputation of a pregnant uterus before the fetus is viable.

Thirdly, the removal of an extrauterine fetus from the abdominal cavity, followed by amputation of the uterus.

This last operation may be performed for rupture of the uterus or vagina with intra-abdominal delivery of the fetus; or, it may be advisable to remove the uterus to control the hemorrhage when operating in these cases of extrauterine pregnancy in the later months.

The indications for the performance of the Porro operation must necessarily include the two indications thought of by Blundell, namely, the removal of the septic uterus and the control of an otherwise uncontrollable hemorrhage. The writer would add to these another indication that has lately come under his notice, namely, the removal of the pregnant uterus on account of gangrene of a fibroid tumor. He had one such case in the summer of 1906. The patient, a negress, had been troubled with a fibroid tumor for some years. She became pregnant. Symptoms of profound sepsis suddenly set in; the tumor became excessively tender and the patient extremely ill. An exploratory incision was made, and the largest nodule of a multinodular myoma, about the size of a child's head, was found gangrenous. Porro's operation was performed and she made an excellent recovery. (Reported by Dr. Thistle, of Toronto.)

There is one absolute indication for the operation, that is, the control of an otherwise uncontrollable hemorrhage. It must then be done to save life. It does not matter what the cause of the hemorrhage is.

There are other indications that are not absolute, and these require careful consideration:

First, the removal of an infected uterus.

Secondly, the removal of the uterus owing to the fact that there is partial or total obstruction of the parturient canal by tumors or excessively rapid growth of a myoma during pregnancy (Fig. 412).

Thirdly, the removal of the uterus on account of osteomalacia.

Fourthly, the removal of the uterus on account of cancerous disease of the cervix.

A uterus may appear to be infected; it may have a greenish appearance of its interior, yet the case may progress satisfactorily if the operation is performed in

the ordinary way and the uterus is left *in situ*. This greenish appearance of the interior is not always an indication of a virulent infection. Moreover, the removal of an infected uterus may not save the patient, nor its non-removal cause her death. Many women are infected subsequent to labor and recover in a short time without the removal of the uterus.

If drainage through the cul-de-sac of Douglas is instituted and the incision made



FIG. 412.—PORRO-CESAREAN SECTION OWING TO RAPID GROWTH OF EDEMATOUS MYOMA DURING PREGNANCY (J. F. W. Ross).

in the posterior wall of the uterus, as has been suggested by Cohnstein, the removal of the uterus is scarcely required; or, if the gauze packing is placed over the uterine sutures in front, as suggested in discussing the operation of Cesarean section, it is unnecessary to remove the infected uterus. The removal of the uterus under such circumstances is certainly not a conservative measure.

When one has seen recovery after rupture of the uterus from prolonged labor or miscarriage, where gauze has been placed down through the opening into the uterine

cavity and on into the vagina, where no sutures have been placed, he must conclude that recovery is quite possible after the uterus has been incised and the fetus removed, even if the uterus is an infected organ. (See Fig. 413.)

The removal of the uterus, because there is partial or total obstruction of the parturient canal from a tumor, is scarcely a justifiable procedure. The removal of a portion of each Fallopian tube is sufficient to prevent subsequent pregnancies, and the patient is thus permitted to retain her ovaries and tubes and all the functions that pertain thereto, with the exception of pregnancy. A contrary opinion is held by others with reference to the advisability of hysterectomy for the pregnant uterus containing fibroids.

In cases of osteomalacia the same argument holds good as in cases in which the pelvis is obstructed by tumors.

It is useless to amputate the uterus in case of cancerous disease. Under such circumstances, pan-hysterectomy, or total removal of the uterus, and not Porro's operation, should be carried out. If this cannot be done, Cesarean section will answer

every purpose. To add the shock of an amputation of the uterus to a patient who has been bleeding for weeks from the cancerous cervix of a pregnant uterus can scarcely be a wise procedure. Such cases have succumbed on the table. The only indication for the removal of a uterus in which cancerous disease exists is the usual one for Porro's operation—uncontrollable hemorrhage. But even though the hemorrhage ceases from the fundus after the amputation, it is likely to continue from the cervix.

If ergot is used judiciously before the performance of the operation, inertia of the uterus will not be so frequently met with, and Porro's operation will not be so frequently indicated.

The fact that so many women have been obliged to have the fetus removed by Cesarean section, in successive pregnancies, is no argument for the performance



FIG. 413.—UTERUS RUPTURED BY HAND OF A YOUNG SURGEON.

Abdominal operation; gauze drainage of wound in uterus. Recovery without removal of uterus (operated on by J. F. W. Ross ten hours after uterus had been ruptured).

of Porro's operation. It has already been shown how this difficulty may be overcome by a simple procedure to prevent subsequent impregnation, namely, resection of the Fallopian tubes.

Operation.—The preliminaries of this operation are similar to those described under the head of Cesarean section. The instruments to be used are the same, except that the operator must provide himself with a small Köberle *serre-nœud* and some piano-wire if he desires to treat the stump by the so-called "extraperitoneal" method. The uterus is drawn out of the abdominal cavity, or it may be left in the abdominal cavity until after it has been emptied, or the membranes may be punctured from below, the amniotic fluid allowed to escape, and the uterus then drawn through the abdominal incision.

If the fetus is not viable, it is unnecessary to open the uterine cavity. A pregnant uterus may be the seat of one or more fibroid tumors that have been growing with great rapidity during the period of pregnancy.

When we are satisfied that it is advisable to remove the uterus, the wire of the *serre-nœud* may be placed around the cervix. In those cases in which the uterine cavity is not opened into, the ovarian and uterine arteries will be ligated before the wire is passed around the cervix. After the ovarian artery has been encircled by a ligature, the ligature is tied, a pair of clamp forceps is placed on the uterine end, the tissues are cut through by means of a pair of scissors, the peritoneum is pushed downward with the handle of a scalpel, and the uterine artery is felt for with the finger and thumb of the left hand. When found, it is held and a ligature passed between it and the cervix, close to the cervical tissue, by means of a blunt pedicle needle. This ligature is now tightly tied and the broad ligament is cut downward, close to the cervix. The ovarian and uterine arteries are similarly tied on the opposite side, care being taken to avoid the ureters. The bladder must not be pinched in the wire of the *serre-nœud* (if it is used). To avoid injury to the ureters, it is necessary that the ligature around the uterine arteries should be placed close to the cervix after the bladder has been mapped out. To avoid the bladder, it is wise to incise the peritoneum over the front of the cervix and to push it downward. Before the first puncture of the pedicle needle is made to secure the uterine artery, it is advisable to place a sound in the bladder to ascertain its exact limitations, and wise to place artery forceps above in the median line and at each upper angle so as to define these limitations. A simple method of determining the limitations of the bladder is compression of the organ by one or two small sponges, forcing the urine to its upper boundaries. They can in this way be easily mapped out and marked by forceps placed upon them as already mentioned. If the clamp is used it is tightened and the uterus amputated.

The writer considers the use of the clamp entirely unnecessary. The old method of treating the stump extraperitoneally by means of Köberle's *serre-nœud* is rarely practised by modern operators. In former days the stump was placed in the lower angle of the wound and supported by transfixing it with pedicle pins. These pins prevented the *serre-nœud* from slipping away from its position. Before the pedicle was placed in the wound, the vesico-uterine pouch was cleansed, the cul-

de-sac of Douglas wiped, and some operators inserted a drainage-tube. The wound was then closed upon the stump. When the stitches were placed the parietal peritoneum adhered to the peritoneum of the stump beneath the wire of the *serre-nœud* and prevented discharge from leaking into the abdominal cavity. The wound was dressed with absorbent pads after it had been dusted with iodoform, *aristol*, or some other powder.

It was desirable that the tissue beyond the wire be mummified, and for this purpose perchlorid of iron solution was used. This was rubbed into the raw surface of the stump, taking care to prevent the iron solution from entering the abdominal cavity and to keep out any discharge of blood that might occur. The wire was tightened if hemorrhage occurred; and if no hemorrhage occurred, it was tightened every day. At the end of a fortnight the clamp came away, together with the strangulated tissues on its distal side. If it loosened, it was not wise to remove it by cutting across the remaining tissues with scissors, as this sometimes caused troublesome hemorrhage. The stump became more or less putrid, and, in some cases, despite all precautions, a distinct odor was apparent. After the clamp was removed a large, cone-shaped hollow was left, red at the bottom and granulating. A considerable time was required for the healing of this hollow. The tissues below gradually retracted and the new scar that formed over the surface became level with the skin. This hollow, unfortunately, formed the site for a large hernia at a subsequent date.

Such an operation cannot, by any means, be considered ideal. There was constant danger that some of the septic material might enter the abdominal cavity. When septic peritonitis did occur, it usually came on about the sixteenth or seventeenth day, just when the operator was congratulating himself that the patient was doing well. In Cesarean section the danger occurs within the first two or three days. In Porro's original operation the danger continued until after the clamp was removed.

There is also the danger that the sloughing process may not be confined to the tissues on the distal side of the wire, but that the tissues on the abdominal or proximal may also slough. As a consequence of this the bladder was sometimes entered or one of the ureters injured. Fortunately, in these cases the uterine tissue is elastic as a result of the pregnancy, and the sloughing is not as likely to occur as in ordinary supravaginal hysterectomy. The bladder has been very tightly compressed by the *serre-nœud* on more than one occasion.

The only type of cases in which the extraperitoneal treatment of the stump offers undoubted advantages is when the uterus is virulently infected or a necrotic and septic tumor is present, and the fetus is dead. In such cases by employing the extraperitoneal method the uterus need not be opened nor the fetus extracted until the abdominal wound has been closed.

In the light of modern experience the intraperitoneal treatment of the stump is the one which should be employed. This treatment was not successful for a time, but the results recently obtained fully justify us in using this method. We now know that if great care is taken to constrict completely the uterine and ovarian

arteries on each side, all subsequent hemorrhage can be controlled by the application of continuous catgut sutures to the pedicle. If hemorrhage is not controlled, it is because the uterine arteries have not been properly tied, and another ligature must be placed closer to the cervix, and farther down, in order to control the small branch that goes to form the circular artery and to anastomose with the artery on the opposite side. Before the lower sutures of catgut are placed it is well to inspect the stump, as it frequently happens that a vessel will be found pumping on the anterior cervical wall, owing, no doubt, to the intimate anastomosis with vesical



FIG. 414.—HERNIA OF PREGNANT UTERUS OWING TO SEPARATION OF RECTI MUSCLES.
Cervical canal pointing upward and backward (J. F. W. Ross).

branches, and another on the posterior wall owing to its connection with the azygos vaginæ artery. These small vessels may be secured with catgut sutures.

After the operator is satisfied that there is no hemorrhage taking place from the uterine stump, the peritoneum is approximated over the broad ligaments and cervix so that the intestines do not come into contact with the raw surfaces. This can be accomplished in a few minutes, and is best done by means of a continuous catgut suture. The technic is the same as that used for the supravaginal amputation in hysterectomy for fibroid tumors; and the subsequent course is also similar to that of hysteromyomectomy. As an extra precaution against peritonitis from

sloughing of the cervix, care should be taken in suturing the peritoneum over the broad ligaments and cervical stump. It may be well to reinforce the peritoneal union by a second continuous suture above the cervix itself to guard against leakage of wound secretions into the peritoneal cavity.

Some operators prefer to puncture the vaginal vault and drain through the cul-de-sac of Douglas, while others place a drainage-tube from the abdominal wound. The drainage-tube is intended to act as a sentinel, and I believe should never be omitted—in this respect differing from most of my colleagues. The tendency among surgeons is to avoid drainage in non-septic cases. The careful ligation of vessels should prevent secondary hemorrhage.

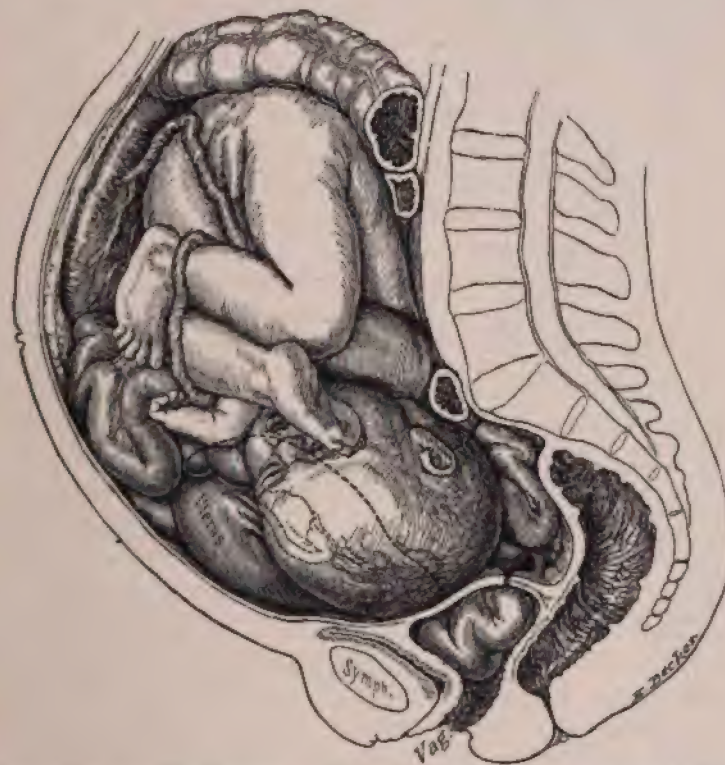


FIG. 415.—SAME AS FIG. 414 AFTER RUPTURE OF VAGINAL WALL AND EXTRUSION OF FETUS AND PLACENTA INTO ABDOMINAL CAVITY.

Note empty uterus (J. F. W. Ross).

Figs. 414 and 415 illustrate a case under the writer's care in St. Michael's Hospital, Toronto, seen by a number of members of the staff. The patient had a hernia of the uterus owing to separation of the recti muscles. During labor the expulsive efforts forced the child against the posterior vaginal wall until it gave way and the fetus and placenta were expelled into the abdominal cavity. The abdomen was opened, the fetus and placenta removed, the uterus left *in situ*, but the patient succumbed.

CHAPTER XXVIII.

OPERATIONS DURING PREGNANCY.

By RICHARD C. NORRIS, M.D.

The results of operations on pregnant women, within the period of aseptic surgery, have convinced the obstetrician that conservatism often means prompt surgical interference, since thereby dangerous complications may safely be removed and maternal and fetal life be saved.

It is not so long ago that the prevailing surgical advice was to operate on a pregnant woman only in case it was necessary to save her from imminent death from the gravest conditions, such as intestinal obstruction, strangulated hernia, or intraperitoneal hemorrhage. The experienced surgeon now operates when he desires to obviate dangers to the mother or child and aims to prevent not only complications dangerous to the life of the mother, but also to prevent abortion or dystocia. In the presence of grave intraperitoneal infections, and for certain tumors surgical interference is often more urgently demanded than when pregnancy does not exist. The latter statement is particularly applicable to acute appendicitis, ovarian tumors, and acute infections of the gall-bladder, with or without the presence of calculi.

Appendicitis.—Statistics are not available to learn the relative frequency of the occurrence of appendicitis during pregnancy and in women who are not pregnant. Treves¹ notes 6 pregnant women among 1000 cases of operation for appendicitis; of 445 women operated upon for acute appendicitis at the German Hospital, Philadelphia (personal communication from H. F. Page), only 6 were pregnant. One was operated upon at the second month of pregnancy, two at the fourth month, two at the sixth month, and one at the seventh month. All the mothers recovered; two miscarried, one at the second and one at the sixth month. Donaghue² found that 80 per cent. of the acute cases during pregnancy occurred during the first six months.

The diagnosis of appendicitis is often obscured by pregnancy. Before the third month the uterus fills the pelvis and makes it difficult to differentiate between the inflammations of the appendix and of the right tube or ovary. After the third month, when the uterus has left the pelvic cavity, right-sided tubal inflammation is even more difficult to differentiate. Nausea, vomiting, and sudden abdominal pain are frequently associated with toxemia of pregnancy. The pain of appendicitis during pregnancy, Pinard³ states, is usually situated over the attachments of

¹ Treves, Sir F.: "Appendicitis after Operation," *British Med. Jour.*, March 4, 1905.

² Donaghue, F. D.: "Appendicitis Complicating Pregnancy," *Boston Med. and Surg. Jour.*, vol. cxlvii, p. 279.

³ Pinard, Prof. A.: "Appendicite et grossesse," *Bulletin de l'Acad. de Méd.*, Feb. 14, 1899.

the diaphragm, and the pulse and temperature may show little or no change. The localization of pain in the region of the liver or on the left side has also been noted by Zweifel. When pregnancy is advanced, rigidity of the right side of the abdomen is not prominent or it may be absent. Palpation over the appendix will best locate pain and tenderness, when the patient lies on her left side. The adhesions that form about an inflamed appendix may fix the uterus, prevent its proper growth and development, and terminate pregnancy; or they may interfere with labor and the puerperium, by preventing contractions, causing hemorrhage or subinvolution and displacement. Miscarriage or labor may cause rupture of an abscess and lead to rapidly fatal peritonitis. The statistics, the clinical and the pathologic histories of appendicitis complicating or antedating pregnancy, clearly prove that this disease at that time is distinctly more dangerous, and that early diagnosis and surgical treatment are more urgently demanded than at other times. The dangers are so great that Webster¹ asserts that a woman who has had an attack of appendicitis should have her appendix removed before pregnancy is permitted to occur.

From a study of 143 cases occurring during pregnancy and the puerperium, collected by Myer,² it appears that when appendicitis has existed prior to pregnancy, a recurrent attack is usual and is liable to be grave, perforation and abscess having occurred in 50 per cent. of such cases. The greatest danger to a pregnant woman stricken with this infection is that of abscess formation, which caused abortion in 57 per cent. of the cases collected, regardless of the treatment, and the occurrence of abortion added 23 per cent. to the mortality of surgical interference. The frequency of the occurrence of abortion in cases not operated, was stated by Fellner³ to be 44 per cent.; while following operation it was 35 per cent. A striking fact is noted in Myer's statistics, which show no cases of interference with pregnancy in 17 cases operated upon for chronic catarrhal appendicitis. The frequency of abortion or miscarriage, whether it be the result of infection spreading to the uterus and its membranes through the appendicular and broad ligament lymphatics, through the blood-current, or by adhesions or abscess formation involving the pelvic organs in its wall, is a fact that warrants surgical interference, at the earliest period of the disease.

If operation is undertaken promptly, before the occurrence of gangrene, perforation or abscess formation, abortion will rarely occur and recovery is the rule. When surgical interference has been delayed and the above named complications are present, operation still affords the best prognosis for both mother and fetus. Operations during the early months are more favorable than those during the latter months of pregnancy.

Of the cases collected by Myer (*loc. cit.*), 52 cases were not treated by operation; of these, 82 per cent. were of the simple catarrhal form; 18 per cent. developed abscesses, of whom two-thirds died, and one-third recovered by spontaneous rup-

¹ Webster, J. C.: "Operations during Pregnancy," Illinois Med. Jour., April, 1904.

² Myer, Max W.: "Appendicitis Complicating Pregnancy," Amer. Jour. Obst., March, 1906.

³ Fellner, A. O.: "Die Chirurgie in der Schwangerschaft," Centralbl. f. Gynäk., Nr. 18, 1905.

ture of the abscess into an adjacent viscus. In 25 per cent. pregnancy was interrupted; the total maternal mortality was 14 per cent.

Of 69 cases treated by operation, gangrene of the appendix or abscess was noted in 71 per cent.; 16 per cent. of the cases aborted before operation and 37 per cent. after operation; the maternal mortality was 32 per cent.

Pinard¹ has reported 30 cases with a mortality of 33 per cent.

Boijee² collected 31 cases of operation for acute appendicitis with a maternal mortality of 41 per cent., and pregnancy was interrupted in 58 per cent. These and other statistics show the great danger to the fetus and to the mother after the occurrence of abscess, and point to early operation before the formation of pus as the only means of diminishing the dangers to both mother and fetus. To lessen the risk of abortion, the uterus should be disturbed as little as possible during the operation, and especially when it happens to form a part of the abscess wall. The removal of a gauze drain is liable to provoke uterine contractions and abortion, and for that reason when drainage is required, the author has preferred a tube or a condom drain. Thorough exploration of the peritoneal cavity is difficult when operation is performed toward the end of gestation, whether the incision be lateral or median. When, late in pregnancy, multiple abscesses are suspected and the uterus must be turned out of the incision, Hirst³ has called attention to the difficulty of returning the uterus through the wound and to the danger of the wound breaking open within a few hours or days after the sutures have been placed. He prefers for these reasons to do a Cesarean section, after the seventh month of gestation, as a part of the operation, and would defer operation, if possible, until the uterus has spontaneously emptied itself. The deliberate emptying of the uterus prior to operation has had a high mortality and should be abandoned. The practical lesson to be learned from the history of this disease in pregnancy is that early diagnosis and operation are paramount, and the surgeon, when in doubt, ought to err on the side of safety rather than to wait for the unmistakable signs of perforation or abscess formation. Even when these have occurred, operation offers the best results for mother and fetus, but it should be remembered that such delay has changed a relatively trivial disease into a disaster.

Cholecystitis.—It has not been proved that pregnancy predisposes to cholelithiasis, as asserted by Frerichs. Fellner collected only 5 cases in 40,000 patients in Schauta's clinic. Kehr has stated that 10 per cent. of women in the child-bearing period of life have gall-stones. On theoretic grounds, therefore, pregnancy and labor have no close relation to inflammation of the gall-bladder. The cases reported by Pinard⁴ and by Christiani⁵ indicate that early operation, as in appendicitis, is

¹ Pinard, Prof. A.: "De la appendic. dans ses rapports avec la puerpéralité," *Ann. de Gynéc.*, Tome xlix, li. liii.

² Boijee, O. A.: "Zur ventrofix. der prolalbirten Gebärmutter," *Mittheil. aus der Gyn. Klinik der Professor Engstrom*, Bd. ii, H. 1.

³ Hirst, B. C.: "Pseudomyxoma Peritonei," *Amer. Jour. Obst.*, March, 1906.

⁴ Pinard, M. A.: "Cholecystite et puerpéralité," *Ann. de Gynéc.*, April, 1903.

⁵ Christiani: "Cholecystitis im Wochenbett," *Monatsch. f. Geburtsh. u. Gynäk.*, Bd. xxi, Hft. 1.

more urgently demanded during pregnancy than at other times. During the puerperal period infection of the gall-bladder may be associated or confused with puerperal sepsis.

Fibroid Tumors of the Uterus.—The life-history of uterine fibroids complicating pregnancy shows that approximately in 75 per cent. of the cases the course of pregnancy, labor, and the puerperium is undisturbed. Very commonly there is a readjustment of the tumor before the end of pregnancy or even during labor, and the pelvic canal threatened with obstruction, is freed for the passage of the child. Of 5500 patients delivered in the General Lying-in Hospital¹ there was no instance of obstruction to labor caused by uterine fibroids. Budin in the Paris Maternité, and Porak and Mace, in the Charité, have recorded similar experiences. Of 2500 deliveries under the author's care at the Preston Retreat, there have been but two cases of uterine fibroids that gave promise of obstructing labor. Both cases were prepared for Cesarean section should the test of labor fail to remove the obstruction, and in both instances spontaneous labor occurred, followed by normal lying-in periods. Winter² studied 23 cases of pregnancy complicated by fibroids, and observed that 5 progressed without any disturbance; 18 had varying degrees of pain and discomfort due to various causes, such as painful uterine contractions, localized peritonitis, or secondary changes in the tumor. Of 14 cases treated expectantly, 9 terminated naturally, 3 aborted, 2 had premature labors. One case required forceps, and one manual removal of the placenta. Six cases were operated upon, of which 4 were radical and 2 conservative. This rather remarkable freedom from complications at labor and during pregnancy does not, however, do away with the necessity for constant observation of the patient and of her tumor throughout the course of her pregnancy, since the many changes that recent investigation has shown to occur in fibroid tumors have not, so far as the author is aware, been proved to occur less frequently when the tumor is associated with pregnancy. On the contrary, some of the changes are notably more prone to occur at that time.

Rapid growth of the tumor, whether from hypertrophy or edema, may cause pain, serious pressure upon the bladder, impaction of the tumor or the uterus in the pelvis, or may occasion excessive rotation of the uterus and thus interfere with fetal growth and development and cause abortion and premature labor. Localized peritonitis with adhesions, blood extravasations into the tumor, necrosis, degenerative changes, and even suppuration and fatal peritonitis are more serious complications. During labor, while obstruction is rare because the tumors are situated in the upper segment of the uterus and commonly subperitoneal, hemorrhage from placenta prævia or submucous tumors and mal-presentations are not so uncommon, and, after delivery, retention of the placenta, requiring manual removal, post-partum hemorrhage, necrosis or infection of the tumor may jeopardize the patient's life. The fact that so many women with fibroids go through pregnancy and labor

¹ Dakin, W. R.: "Effect of Childbearing on Fibroid Tumors of the Uterus," *Jour. of Obst. and Gynec. of the Brit. Empire*, August, 1904.

² Winter, A.: "Myom und Gravidität," *Monatsch. f. Geburtsh. u. Gynäk.*, Bd. xx, S. 263.

without complications does not remove the necessity for careful and unremitting supervision of each individual case in order to avert disaster by prompt operation. When there are no symptoms produced by the tumor before the fetus has reached a viable age, the most important and often a difficult problem is to determine whether or not the tumor will obstruct labor. Tumors situated above the supravaginal cervix (the obstetric upper uterine segment) never offer obstruction except those with long pedicles, and these can usually be replaced by gently lifting them out of the pelvis, if the displacement is detected early and before impaction. Tumors located in the supravaginal cervix, if anterior, almost never obstruct labor. The writer has repeatedly observed them grow above the pelvic brim during pregnancy and have no ill effect upon either labor or the puerperium. When located posteriorly their rapid growth may lead to impaction with adhesions, the tumor having been caught below the sacral promontory. In three such cases the writer has removed the impacted tumor by abdominal myomectomy without interrupting pregnancy. Intraligamentary and cervical fibroids are most likely to cause obstruction, since one cannot expect them during labor to be drawn upward and away from the birth canal by the longitudinal fibers of the lower uterine segment. The old practice of forcible attempts to dislodge a pelvic bound tumor by pressure, manual or hydrostatic, with or without an anesthetic, must be abandoned. Mistaken diagnosis, grave accidents, and surgical tragedies have often resulted from such treatment, and, contrasted with the excellent results of elective surgery, one can only conclude that forcible replacement should never be attempted. The results of inducing abortion are almost equally disastrous, and should also be abandoned, except in the rare instances when anesthesia, general or spinal, cannot be used or when a tumor is so situated, as an interstitial growth near the cervix, that by inducing abortion a subsequent myomectomy may be more safely done and a future pregnancy be unobstructed.

Experience has shown it best to allow pregnancy complicated by fibroid tumors to continue so long as urgent symptoms are absent and to operate on obstructive cases a few days before term. If the case presents any prospects of relief from the obstruction by uterine contractions during labor, and the patient can be placed in a surgical environment affording facilities for operation at any time, as in a hospital, the operation may be performed after the test of labor. It is well to remember, in all cases progressing favorably, that labor not infrequently occurs prematurely, and provision should be made for such an emergency.

Having delivered the child by Cesarean section, if conditions specially favorable for myomectomy—a single or very few and small additional pedunculated tumors—are present, that operation may be selected. Usually the dangers of hemorrhage from faulty contraction of the uterus, of insecure stitches in an irregular incision made necessary by multiple and sessile growths, will indicate the necessity for hysterectomy. At term a cervical fibroid can often be enucleated and removed per vaginam and the delivery at once accomplished by forceps or version. During pregnancy when the rapid growth of multiple tumors or a single pelvic bound tumor produces grave pressure symptoms threatening fetal life, or the mother's life is jeopardized by degenerative processes in the tumors, or her heart and excretory organs

show signs of failing power, delay is dangerous, and myomectomy or hysterectomy are the operations to be considered. There has been considerable controversy as to the respective merits of these operations during pregnancy, and before discussing them the author is constrained to state his conviction that the limited field of myomectomy has even greater restrictions during pregnancy. For the relief of pressure symptoms before viability of the fetus it is the ideal operation for a single pedunculated or sessile tumor with a narrow and shallow base. Large interstitial growths, the variety most likely to take on rapid growth during pregnancy and to encroach upon the uterine cavity, or multiple tumors requiring many incisions, increase the danger of insecure stitching following abortion which is frequent after the removal of such tumors, and render the operation under those conditions distinctly more dangerous than hysterectomy. Although it is argued that the special justification of myomectomy is the saving of fetal life, the added risk to the mother and the frequency of abortion following myomectomy do not warrant its selection except under the most favorable conditions as noted above. Stavely studied the results in 32 cases, and found abortion followed in 30.3 per cent., the maternal mortality between 1885 and 1889 being 16.88 per cent.; between 1889 and 1894, 11.75 per cent.

J. Duncan Emmett¹ collected 44 cases between 1890 and 1900 that gave a maternal mortality of 9 per cent. and a fetal mortality of 21 per cent. Winter² more recently, however, reports only 11 abortions following 58 cases of subsero-interstitial tumors, and states his belief that pregnancy in no respect adds to the mortality of myomectomy. Statistics, after all, are often misleading, and careful perusal of the histories of individual cases has convinced the writer that it is very seldom justifiable to depart from the usual contraindications of myomectomy and thus add a risk to maternal life in order to gain an uncertain advantage for the fetus. Each case when brought to operation must be a law unto itself, and only when the operator's skill and judgment plainly indicate the safety of myomectomy should that operation be performed. It is in those cases when the usual contraindications have been abandoned with the hope of saving the child that the maternal mortality of myomectomy has been greatest.

Cervical polyps, mucous or fibroid, rarely cause abortion when removed during pregnancy, and with care not to injure the amniotic sac they may be removed at any period of pregnancy.

Amputation of the Cervix for Hypertrophy of the Vaginal Portion.—The prognosis of this complication is grave for both the mother and the child. The obstacle to dilatation makes the length of labor, with the usual premature rupture of the membranes, a distinct danger to the child, and to effect delivery deep incisions into the cervix followed by forceps extraction or vaginal or abdominal Cesarean section may be required. Potocki³ has shown that grave accidents are common

¹ Emmett, J. Duncan: "Myomectomy During Pregnancy," *Amer. Gyn. and Obst. Jour.*, June, 1901.

² Winter: "Die wissenschaftlichen Grundlagen der Conservative Myomoperation," *Zeitschr. f. Geburtsh. u. Gynäk.*, Bd. li, Nr. 5.

³ Potocki: "De l'amputation du col pendant la grossesse dans le cas," *Ann. de Gyn. et d'Obstet.*, 1906, iii, 709.

enough to justify interference before pregnancy is well advanced. He collected eight cases of amputation during pregnancy with only one abortion following the operation. The amputation should secure perfect coaptation without subsequent cicatrices, should be done in the fourth month of pregnancy, when abortion is least likely to be produced, and the uterus, during the operation, should not be forcibly dragged into the vagina.

Ovarian Tumors.—Pregnancy, as a rule, does not cause the increase in growth observed in uterine fibroids, but some of the complications that may arise in the life-history of ovarian tumors are more likely to occur during pregnancy. This is true of attacks of peritonitis followed by adhesions, and of torsion of the pedicle, which is especially liable to occur when the tumor is situated above the pelvic brim, and particularly in the puerperal period, when the frequency of this accident is increased threefold. Pressure symptoms are aggravated, and rupture and suppuration, the latter being more likely in dermoid tumors, are accidents more commonly observed when the tumors are small and remain in the pelvic cavity, often undiscovered until acute symptoms occur. In an admirable study of this subject comprising a series of 1290 cases McKerron¹ found one in four ovarian tumors complicating pregnancy to be dermoid, and from their greater liability to remain in the pelvis (three out of every five cases) they are, next to cancerous growths, distinctly the most dangerous variety. Swan² could find only 14 undoubted cases of solid tumors of the ovary complicating pregnancy. Including malignant growths, serious complications during pregnancy, labor, or the puerperal period may be expected in from 25 to 30 per cent. of all cases, and from 16 to 20 per cent. of the pregnancies will terminate prematurely.

Adding thereto the dangers to the child from operative deliveries necessitated at term, the infant mortality rises to 30 or 35 per cent. McKerron's tables show that in 720 cases not operated upon the maternal mortality is 21 per cent., the fetal 30 per cent. Of recent cases collected by him, the results of operation are shown in the following tables:

RECENT CASES (OPERATION); MATERNAL AND FETAL MORTALITY.

MONTH OF PREGNANCY.	NUMBER OF OPERATIONS.	MATERNAL DEATHS.	PERCENT-AGE MORTALITY.	NUMBER OF OPERATIONS.	PREGNANCY INTERRUPTED AND CHILD LOST.	
					ALL CASES.	EXCLUDING COMPLICATED CASES.
					Per cent.	Per cent.
Second.....	28	0	0.0	28	6 20.7	5 18.5
Third.....	62	2	3.2	60	9 15.0	5 8.8
Fourth.....	62	3	4.8	60	7 11.6	3 5.3
Fifth.....	41	2	4.8	38	8 21.0	2 6.2
Sixth.....	22	0	0.0	22	8 36.3	4 22.2
Seventh.....	15	1	6.6	15	5 33.3	3 20.0
Eighth.....	7	0	0.0	7	4 57.1	4 57.1
Ninth.....	7	0	0.0	6	0 0.0	0 0.0

¹ McKerron, R. G.: "Pregnancy, Labour and Child-Bed with Ovarian Tumour," London, 1903.

² Swan, Wm. E.: "Tumors of Ovary Complicating Pregnancy," Johns Hopkins Hosp. Bull., March, 1898.

During the twelve years preceding 1903, he collected 299 ovariectomies during pregnancy and, although in many of these acute symptoms existed at the time of operation, the mortality was 3.3 per cent. Omitting the unavoidable deaths, the mortality was 2.3 per cent. In his total series of cases pregnancy was interrupted in 20 per cent. When no complications existed at the time of operation the proportion was 11 per cent. In 94 labors obstructed by pelvic ovarian tumors the maternal mortality was 9.5 per cent., and in 50 abdominal ovarian tumors not operated on during pregnancy the mortality was 10 per cent. The only conclusions possible from these results are that when no other complication exists pregnancy at any period may be disregarded as a factor in maternal mortality, and that ovariectomy under the conditions just noted, and even when premature termination of pregnancy is threatened, adds practically no danger to fetal life. A careful study of this subject from every viewpoint of either the abdominal surgeon or the obstetrician will convince both of the desirability of the early recognition and removal of an ovarian tumor complicating pregnancy. Operations performed during the third or fourth month have given the best results. The older methods of treatment, tapping or the induction of abortion or premature labor, are almost never to be employed, and can only be considered under the most exceptional conditions. The former will best conserve the child's interest, when, late in pregnancy, a monocus, firmly adherent to the uterus, can be temporarily relieved and, the child having been delivered, the cyst should be removed immediately after labor. The induction of abortion or premature labor will be justified only in the presence of grave systemic or advanced malignant disease that contraindicates ovariectomy.

During an operation for the removal of an ovarian tumor complicating pregnancy, and especially if abortion or labor is imminent, the least possible manipulation of the uterus is desirable. When, however, the tumor is pelvic bound, the uterus, protected with gauze and warm salt solution, should be turned out through the incision to favor enucleation of the cyst. The opposite ovary should always be examined. The usual care not to rupture a dermoid cyst, its relative frequency and cause of acute symptoms, should place the operator on guard for this variety of tumor. In difficult enucleation if the uterine wall is seriously torn and the membranes are penetrated, Cesarean section should be resorted to at once. The dangers of infection should abortion occur, and the difficulty of dealing with adhesions or hemorrhage, render the abdominal operation safer than operation per vaginam.

Vaginal Fistulæ.—A fistulous opening into either the bladder or rectum is an unfortunate complication of pregnancy and may prove a danger at the time of labor or during the puerperium. This is especially true of large openings, whether vesicovaginal or rectovaginal, and numerous cases of their repair during pregnancy without the occurrence of abortion make these operations justifiable to prevent the danger of infection at delivery or during the lying-in period. Noble (personal communication) has operated on one case of large vesicovaginal fistula with satisfactory union and without interruption of the pregnancy. Repair of a laceration of the sphincter ani muscle during pregnancy has also been frequently performed

with success. Although the presence of fecal discharges at the vaginal introitus adds a risk of infection from examinations during labor and from contamination during the puerperium, these dangers may be avoided with due care. It has, therefore, seemed unnecessary to the writer to repair a lacerated sphincter during pregnancy. Moreover, the liability of the recently formed scar tissue to give way in the perineal stage of labor renders the operation less desirable than in the late puerperium.

Urinary Tract.—A *vesical calculus* complicating pregnancy should be removed at the earliest possible period of pregnancy. If its size does not permit removal through a speculum after safe dilatation of the urethra, lithotripsy or vaginal lithotomy is indicated.

Ureteritis, Pyelitis, and Pyonephrosis.—Infection of the ureter and pelvis of the kidney during pregnancy may not be preceded by cystitis. The important factor is believed to be compression of the ureter by the pregnant uterus, predisposing to infection of the ureter, very often by the colon bacillus, or less frequently by other bacteria. Appendicitis, salpingitis, and typhoid fever are conditions that may confuse the diagnosis. Opitz¹ analyzed 64 cases. The right side was more frequently involved, due in part to the course of the right ureter. The symptoms occur most frequently during the fifth to the seventh month. Of 18 cases collected by Smith,² the results in 15 were as follows: in 11 the course of pregnancy was unaffected, the pus disappearing from the urine in 8 of them before labor; 4 cases miscarried, the temperature in three of these having risen to 104° F. In two cases the pyelitis progressed to pyonephrosis after labor. One recovered from nephrectomy four months after labor (colon bacillus infection); the other died after nephrotomy, pyonephrosis being found on one side and hydronephrosis on the other. The necessity for terminating pregnancy or for surgical treatment is not universally recognized. Usually pyelitis will improve when treated by milk diet, urinary antiseptics, and relief from pressure, in the early months by a pessary, in the later months by posture (Trendelenburg or periods of the knee-chest posture). When the case becomes threatening before the period of viability of the child, the induction of abortion or surgical treatment is necessary. Distinct enlargement of the kidney or its pelvis always calls for interference. Nephrotomy and nephrectomy have been recommended, and have been successful in saving fetal life, as in the cases reported by Kendirdjy,³ and by Sippel,⁴ but most obstetric surgeons prefer to terminate pregnancy and operate subsequently if necessary. Ten successful pregnancies following removal of one kidney have been collected by Noble.⁵ In these cases the one kidney has gradually gained its compensatory excretory power and

¹ Opitz, E.: "Treatment of Puerperal Pyemia," *Deutsch. med. Wochenschr.*, 1904, Nr. 51.

² Smith, G. B.: "Pyelitis in Pregnancy," *Jour. of Obst. and Gyn. of the Brit. Empire*, August, 1905.

³ Kendirdjy, Léon: "Des pyélonéphrites de grossesse," *Gaz. des Hôpitaux*, 1904, No. 41, p. 393, and No. 44, p. 425.

⁴ Sippel, A.: "Pyonephrosis, Pyelitis und Harnleiterkompression während des Schwangerschaft," *Zentralbl. f. Gynäk.*, 1905, Nr. 37.

⁵ Noble, Chas. P.: "Nephrectomy followed by Pregnancy," *American Medicine*, May, 1906.

has been equal to the demands of subsequent pregnancy. The increased danger of the stress thrown suddenly on the remaining kidney during pregnancy has led most obstetricians to prefer the induction of labor, which often removes the necessity for surgical treatment.

Affections of the Vulva.—*Cysts of the vulva*, if large or growing rapidly, should be excised, and the wound closed if there is sufficient time to obtain union before the onset of labor. At term evacuation and drainage by means of a gauze pack are preferable.

Abscess of Bartholin's gland should be freely incised, the gland excised if possible, and after disinfecting the wound it may be partially closed and drained. The possibility of infection during and after labor renders this complication near the end of pregnancy a serious one, and adds distinct dangers to vaginal examinations or operative delivery.

Hematoma of the vulva, if large or suppurating, should be opened and drained.

Pelvic Inflammations.—Acute pelvic inflammations complicating pregnancy are very rare. Spontaneous abortion is usual, and prompt operation may save fetal life. Pregnancy and localized pelvic inflammation will have a history of excessive pain and often of repeated miscarriage, and require a careful examination, usually with the patient anesthetized. If a mass is discovered, or the uterus is displaced and held by firm adhesions which resist judicious efforts for replacement, operation is indicated. Impaction or incarceration of the gravid uterus is also best treated by abdominal section when gentle efforts or hydrostatic pressure have failed. Forcible reposition should never be employed; Jacobs, Mann, and others have reported brilliant results following abdominal operation for these cases. Neglected cases of impaction of the uterus, with necrotic or gangrenous changes in the uterus or bladder, add great danger to abdominal operative treatment, and, like a large pelvic abscess complicating pregnancy, will sometimes be better treated by inducing abortion and subsequently draining the pelvis per vaginam.

Malignant Growths.—*Carcinoma of the Cervix.*—The surgical treatment of malignant disease of the cervix complicating pregnancy depends upon the progress of the disease and the period of pregnancy when recognized. In the first half of pregnancy an operable case is best treated by vaginal hysterectomy; after the fifth month, by abdominal complete hysterectomy, or the uterus may be emptied and removed by vaginal hysterectomy—the most recent technic being that of Dührssen, and named by him vaginal Cesarean section. An inoperable case permitted to go to term in the child's interest may require Cesarean section followed by the usual palliative treatment.

Operable *carcinoma of the rectum* requires the induction of abortion and later the removal of the rectum. Inoperable cases, if the fetus is living, will require Cesarean section at term. Nijhoff¹ has reviewed 26 cases. In Kjelberg's case the growth was extirpated at the fourth month without interrupting pregnancy. Petersen's case aborted four days after extirpation and died the following day of peri-

¹ Nijhoff, G. C.: *Schwangerschaft und Carcinoma recti*, "Zentralbl. f. Gynäk.", Nr. 28, 1905.

tonitis. Extirpation several days after induced abortion has given the best results.

Dental Operations.—Dentists usually follow the rule that only temporary operations upon the teeth should be undertaken during pregnancy, and recognize that intense pain and shock are especially dangerous. Custer¹ discusses this subject and states that non-interference in serious cases, such as difficult cavities with exposed pulps, phagedenic pericementitis, abscess, impacted third molars, can produce abortion, and that operation for their relief and cure is indicated, an anesthetic being employed to avoid shock.

Oakman² also believes that it would be unwise to allow a woman to suffer from neuralgia, odontalgia, alveolar abscess, carious bone, or diseased antrum, which cause great pain or suppuration. Temporary operations are especially to be employed in cases of highly sensitive and neurasthenic women. Prolonged sittings, great pain, anxiety, and shock are always to be avoided.

Preliminary and Post-operative Precautionary Management.—Increased irritability of the nervous system during pregnancy, and of the uterus at the menstrual epochs, has doubtless some relation to the occurrence of abortion after surgical operations. A hopeful and encouraging attitude of the surgeon, the use of nerve sedatives, and, when possible, the selection of a time for operation when the patient is not in or near a menstrual epoch are desirable precautionary measures. To avoid the stage of excitation of etherization, chlorid of ethyl may be used, and is, on theoretic grounds, less dangerous to the fetus than the asphyxia of nitrous oxid gas. Intraperitoneal operations should be conducted through the smallest incision compatible with rapid and thorough work, and especially should the pregnant uterus be handled as little as possible. Rather than prolong the manipulation of the uterus it is better to at once enlarge the incision, gently turn the uterus out through the wound, and wrap it in gauze wet with warm salt solution, in order to facilitate the quick removal of a pelvic bound growth. Following an operation of any magnitude, chloral or bromids to allay nervousness, and especially opium and viburnum prunifolium in full physiologic doses for several days, are of undoubted value to diminish the risk of abortion or premature labor. After abdominal operations in which gauze drainage has been used, the removal of the latter, especially when adjacent to the uterus, will excite uterine contractions and may provoke an abortion or premature labor. The condom or cigarette drain will prevent firm adhesions, and is therefore preferable when gauze drainage is required. The uterine sedatives above referred to should be continued until the drainage appliances have been removed. To insure firm union of the abdominal wound and to fortify the scar against the unusual stretching incident to pregnancy, it is desirable to have the patient rest in bed for three weeks after the operation and to wear a properly fitted abdominal supporter throughout the pregnancy.

¹ Custer, H. T.: "Dental Operations during Pregnancy," Dental Cosmos, vol. xxxix, p. 154.

² Oakman, C. H.: "Dental Treatment during Pregnancy," Dental Cosmos, vol. xlvi, p. 495.

CHAPTER XXIX.

THE OPERATIVE TREATMENT OF SEPSIS IN THE CHILD-BEARING PERIOD.

BY BARTON COOKE HIRST, M.D.

The medical treatment of puerperal sepsis has already been discussed in Chapter IV, Vol. I. The operative treatment of this condition comprises, first, the routine instrumental exploration of the uterus; second, vaginal section; third, celiotomy.

The Routine Instrumental Exploration and Evacuation of the Uterus in the Treatment of Sepsis after Labor.—These terms are used advisedly instead of that much misapplied expression “curetment of the puerperal uterus.” Experience teaches the necessity of this procedure in the majority of septic cases. There is usually a mass of hypertrophied and necrotic decidua in a septic uterus the removal of which benefits the patient. No one can tell the condition of the uterine cavity until it is explored. Consequently the following procedure is essential in the treatment of the majority, if not all, infected puerperæ: The vulva and vagina are disinfected; a bivalve speculum (Collins) is inserted and widely distended; the cervix is wiped off with pledgets of cotton and sublimate solution and an Emmet’s curet forceps is gently inserted into the uterine cavity, cautiously opened and closed in all directions; if there is any doubt as to the removal of all the necrotic material, a broad dull curet is held between the thumb and forefinger and with the greatest gentleness is passed lightly over the uterine walls. If there is nothing in the uterus to be removed there is no result; if there is, it is discovered and removed at the same time, without traumatism, without pain, and without anesthesia. The insertion of the whole hand in the uterus in the early puerperium will tear open wounds of the genital canal and is usually so painful to the patient as to demand an anesthetic. The gentle use of instruments is painless and is much quicker.

The reason that instrumental exploration and evacuation of the puerperal uterus has fallen into disrepute is that the average physician has carried it out like curetment of the non-puerperal uterus, a procedure necessarily often followed by fatal general infection or even by perforation of the uterus.

Vaginal Section for Pelvic Suppuration or for Infection of the Pelvic Connective Tissue.—Whenever in the course of puerperal infection there are physical signs of an abscess in Douglas’ pouch and no evidence of involvement of the general peritoneal cavity, or in case abdominal section is indicated but the woman’s condition is too bad to admit of it, a colpotomy of the posterior vaginal vault and an irrigation of the pelvic cavity with sterile water are indicated. After cleansing the vagina with tincture of green soap and a sublimate douche,

the mucous membrane of the posterior vaginal vault is incised with a knife, and then, with sharp-pointed scissors or the fingers, the opening into the peritoneal cavity is completed. Adhesions are cautiously separated so as to avoid opening the general peritoneal cavity and the pelvic organs are carefully palpated to detect isolated foci of suppuration, which if found are opened. The pelvis is irrigated through a two-way catheter with sterile water and then packed quite firmly with a strip of iodoform gauze. The vagina is also packed. The pelvic packing is removed in forty-eight hours and is replaced by a T-shaped rubber drainage-tube, through which the pelvic cavity is irrigated daily with sterile water for ten to fourteen days. Incisions in the lateral fornices and gauze drainage are of service in suppuration of the parametrium or in accumulations of infected serum in it.

Pryor¹ advises a routine examination of the uterine interior by means of Döderlein's method in order to determine the nature of the infection. After that he washes out the uterus with Thiersch's solution and packs it full of iodoform gauze, 10 to 20 per cent. strength. He does not curet the uterus if the streptococcus has been found. The posterior cul-de-sac is then opened by a broad incision. In all cases a quantity of fluid escapes, either serum, serolymph, or seropus, or even pure pus. In case there is much effusion of lymph and the organs are matted together, all adhesions are rapidly broken up by the fingers. The uterus is now lifted up and the posterior vaginal wall depressed. The pelvis is packed full of iodoform gauze, 5 per cent. strength. The pelvis is completely filled from side to side, the first piece being placed well to one side of the pelvis over the iliac vessels and extending to the pelvic brim. When the packing is complete, the iodoform gauze is in apposition with the posterior layers of the broad ligament and the uterus and is in contact with all that pelvic portion of the peritoneum which overlies those lymphatics and veins which carry the infection. In forty-three cases he reports a mortality of 2 per cent.

Indications for Abdominal Section in the Treatment of Puerperal Sepsis. Since the first performance by Tait of abdominal section for purulent peritonitis there has been an extremely important development, especially in the last decade, in the scope of pelvic and abdominal surgery for septic inflammation during the child-bearing period.

Regarded at first as a procedure analogous to opening an abscess anywhere in the body, the whole abdominal cavity being looked upon as an abscess-cavity and the abdominal walls as its capsule, abdominal section for puerperal sepsis has become a generic term of wide significance, including hysterectomy, salpingo-oöphorectomy, evacuation of abscesses in the peritoneal cavity and in the pelvic connective tissue, removal of gangrenous or infected neoplasms either of or in the neighborhood of the parturient tract, and exploratory incisions.

It is more convenient to deal generically with the indications for abdominal section in the course of puerperal sepsis, for the operation is usually decided upon in practice without reference to what may be required after the abdomen is opened,

¹ Pryor, W. R. "Puerperal Sepsis." *Proceedings of the Obstetrical Society of Philadelphia, Annals of Gyn. and Pediat.* March, 1904, p. 150.

the surgeon being prepared to perform any of the pelvic or abdominal operations detailed above that may be found necessary when the abdominal cavity is exposed to view and to touch.

In order to decide correctly the important and anxious question for or against celiotomy in the course of puerperal septic fever, the medical attendant must be familiar with the different forms of sepsis after labor, and should know which of them are most and which are least amenable to surgical treatment. In a general way, it may be stated that the operation is demanded most frequently for localized suppurative peritonitis; it may be indicated, and often is, for diffuse suppurative peritonitis; for suppurative salpingitis and ovaritis; for suppurative metritis, if the inflammation extends outward toward the peritoneal investment of the womb or into the connective tissue of the broad ligament; for abscesses in the pelvic connective tissue; for infected abdominal or pelvic tumors. On the contrary, abdominal section is contraindicated or is not required in simple sapremia; in septic endometritis of all forms, necrotic, pseudo-membranous, ulcerative, suppurative; in dissecting metritis, sloughing intrauterine myomata (with occasional exceptions), or in suppurative metritis with the abscess pointing into the uterine cavity; in phlebitis, lymphangitis, and in direct infection of the blood-current. One is most likely to perform an unnecessary operation for septic endometritis. When symptoms justify surgical intervention in this condition, it is always too late.

It is extremely difficult to lay down correct rules for the guidance of a physician in a situation involving so much responsibility, and of necessity so dependent upon many circumstances, as that seeming to require a very serious surgical operation in the midst of an adynamic fever with profound depression, rapid pulse, high temperature—in short, with everything a surgeon least desires in the face of a major operation.

First and foremost, then, the surgeon should avoid the operative treatment of puerperal sepsis if possible, and should not seek an excuse for surgical intervention merely in the cardinal symptoms of septic infection—high temperature, rapid pulse, and general depression. He should demand some tangible evidence of those forms of sepsis that are amenable to surgical treatment. But while reluctant to operate upon a patient under the least favorable circumstances, and on his guard against unnecessary or harmful surgery, the surgeon must be prepared, in the event of certain symptoms or complications, to operate with the least possible delay.

Thus, on the very first appearance of symptoms that justify the diagnosis of diffuse suppurative peritonitis, the abdomen must be opened without a moment's more delay than is necessary for an aseptic operation. Even with the utmost promptness the operation is almost always too late, for the inflammation extends so rapidly, and at first insidiously, that by the time a diagnosis is possible the progress of the disease cannot be stayed. It must be admitted, however, that an occasional success is possible by timely surgical interference.¹

¹ Hirst: "A Diffuse, Unlimited, Suppurative Peritonitis in a Child-bearing Woman Cured by Abdominal Section," *Medical News*, 1894. A unique case in my experience.

Again, in the presence of exudate, adhesions, or unnatural enlargement of any pelvic structure, suppuration may be suspected if the physical signs do not improve and if the temperature, pulse, and general condition indicate a continuance of septic inflammation. It is hardly necessary to state that if pus forms it must be reached and evacuated irrespective of its situation. Just how long to wait, however, is a question requiring experience, good judgment, and a special study of each individual case for its correct answer.

Enormous pelvic and abdominal exudates may disappear; adhesions may melt away; enlarged and inflamed tubes, ovaries, and uterus may resume their proper size, functions, and conditions on the subsidence of the inflammation; but in these favorable cases distinct signs of improvement manifest themselves in a few days, and the course of the disease is comparatively short. A mere protraction of septic symptoms is in itself suspicious, *along with local signs of inflammation*. Without the latter, the same general symptoms, sometimes lasting for months, indicate phlebitis and infection of the blood-current. In this form of sepsis an operation can do no good and may do the greatest harm.

In infected tumors of and near the genital tract the indications for operation should be plain and the decision easy. The presence of the tumor should, of course, be known. On the first sign of inflammation in it, or in the event of an elevated temperature for which there is no good explanation, the tumor should be removed. Early operations in these cases have furnished the best results, delayed operations the reverse.

In cystic tumors the likelihood of twisted pedicle should be remembered, and in every case of childbirth complicated by a new-growth the woman should be watched with extraordinary care to detect the first indication of infection.

An exploratory abdominal incision should be made, as a rule, only when it is desirable to determine whether a pelvic mass, presumably containing pus, is situated within or without the peritoneal cavity, and whether the abscess should be evacuated through the abdominal cavity or extraperitoneally. In the early period of experimentation with abdominal section for puerperal sepsis exploratory incisions were made in obscure cases without any local symptoms of inflammation in the pelvis or the abdomen. None of these operations yielded information of value, nor did they benefit the patient. Consequently, it is a safe rule not to open the abdomen of a puerpera for sepsis unless there are physical signs of inflammation of the abdomen or the pelvis.

This is not the place to discuss the symptoms of diffuse suppurative peritonitis, but one fact should be insisted upon from the operator's point of view. It is usually supposed that true diffuse suppurative peritonitis appears early after delivery; it may, however, develop at any time, as late as four weeks after confinement. The technic of the operation is simple: a small incision is made in the median line and the finger is rapidly swept about the pelvis and abdomen to determine the condition of the organs; then the irrigating tube is passed into the cavity at the lowest angle of the wound, and is swept about in all directions, while the return-

flow is provided for by two fingers of the left hand distending the sides of the wound, which by the fingers and the irrigating tube is kept gaping as though by a trivalve speculum. The irrigation tube is then pushed as far as possible, first into one flank and then into the other, and the tip is cut down upon through the lateral abdominal wall. The posterior vaginal vault is then punctured from above. Gauze and glass-tube drainage into the pouch of Douglas, a strip of gauze through the puncture of the posterior vaginal vault, and a gauze drain in the flanks are provided for, the wounds are left open, or, at most, drawn together by a stitch or two. Rapidity of operation and the smallest quantity of an anesthetic are essential to success. The gauze drains are withdrawn gradually, beginning on the fourth day.

Trendelenburg,¹ observing that in forty-three autopsies on women dying of puerperal sepsis twenty-one had pyemic thrombosis, advised ligation and excision of the pelvic veins in the treatment of this condition. He reported one successful case.

Opitz,² after an extensive review of Trendelenburg's plan and the report of a number of cases, says that the ligation and excision of diseased veins with or without total extirpation of the uterus is at best successful only in exceptional cases, and the indications for it are almost impossible to determine. He believes that non-operative, general and supportive treatment is better.

This proposition has been sufficiently tried in practice to warrant an opinion that the mortality of surgical intervention in these cases is greater than that of palliative treatment, and that the operation is not to be recommended.

Following these general statements in regard to abdominal section for puerperal sepsis, it is more convenient to describe in detail the different kinds of operations required for the various forms of intra-abdominal septic inflammations.

Abdominal Section for Intraperitoneal Abscesses and Diffuse Suppurative Peritonitis.—The situation and the extent of localized suppuration within the abdominal cavity vary greatly. A quarter of the abdominal cavity may be filled with pus, the huge abscess-cavity being thoroughly walled off by dense exudate from the rest of the abdominal cavity. A smaller accumulation of pus about the orifice of the tube is not uncommon. In some cases two or three abscesses the size of an orange may be found between coils of intestine quite far removed from one another, and without apparent connection with the genital tract. In three of the writer's cases abscesses were found between the fundus uteri and the adjoining structures—the abdominal wall near the umbilicus in one, the caput coli in the second, and the sigmoid flexure in the third. In these cases infection had traveled through a sharply defined area of uterine wall and had appeared in the same limits on its peritoneal investment. Exudate and adhesions immediately walled off the infected area, with the result of an encapsulated abscess between the uterine wall and the structure nearest to it at the time of inflammation. The treatment of these

¹Trendelenburg, F.: "Ueber die chirurgische Behandlung der puerperalen Pyämie," *Münch. med. Wochenschr.*, April 1, 1902, No. 13, pp. 5-13.

²Opitz, E.: "Ueber Heilungsaussichten und Behandlung der puerperalen Pyämie," *Deutsch. med. Wochenschr.*, 1904, No. 25, p. 910; No. 26, p. 953; No. 27, p. 986.

abscesses is their evacuation, the cleansing of the cavity, and drainage. The cleansing may be effected by flushing with hot sterilized water, if the rest of the abdominal cavity can be guarded from contamination. In many cases it is better to avoid irrigation and to thoroughly dry the cavities with gauze. For drainage, as a rule, sterile gauze with a glass or rubber tube is usually best. In certain cases of abscesses near the abdominal wall, a rubber tube answers better than the gauze, and in deep-seated abscesses on the base and the back of the broad ligaments vaginal drainage by means of gauze or rubber tube is much to be preferred. If the work during the operation is well done, there may be little or no subsequent discharge, and douching of the abscess-cavities during convalescence is uncalled for. Occasionally, however, if the abscess-cavity is very large and well isolated, daily douching with sterile hot water is an advantage. In diffuse suppurative peritonitis the remote chance of success depends greatly upon the earliest possible operation and the most thorough drainage, though there are many virulent cases in which nothing could check the spread of the inflammation and the deadly effect of septic intoxication.

Salpingo-oöphorectomy for Puerperal Sepsis.—It should be remembered that *tubal or ovarian abscesses in the puerperium are preferably treated by vaginal incision and drainage*. When from their position this is not feasible, salpingo-oöphorectomy may be required. An acute pyosalpinx in the puerperium is very rare. It is uncommon for the acute septic infection after labor to travel by the tubes alone. Infection usually occurs in the uterine muscles, the veins, the lymphatics, or the connective tissue of the pelvis. When the tract of the septic inflammation is confined to the mucous membrane of the genital tract, the pelvic peritoneum, in a case serious enough to demand operation during puerperal convalescence, becomes infected and inflamed; suppuration quickly follows, so that the operation is usually performed for an intraperitoneal pelvic abscess. The tube may be found somewhat swollen, dark red in color, containing a few drops of pus, with flakes of purulent lymph on its external surface, and its removal is required; but the pyosalpinx is a subordinate feature in the pelvic inflammation. It is the more subacute case, not usually requiring operation in the conventional period of the puerperium, that results later in a typical uncomplicated pus-tube.

Ovarian abscess is much more common than pyosalpinx. The infection may travel to the ovary, both by way of the tube and by the connective tissue, the blood-vessels, or the lymphatics of the broad ligament. In the latter case the whole ovary may be infiltrated with a thin sero-pus of a particularly virulent character, and, unfortunately, in excising the ovary the exposure of the infected pelvic connective tissue in the stump may lead to infection of the peritoneal cavity and to a diffuse suppurative peritonitis.

The commonest indication for salpingo-oöphorectomy is furnished by a pus-tube antedating conception. The strain of labor excites a fresh outbreak of inflammation, which leads to its spread, and the persistence of septic symptoms with the physical signs of pelvic inflammation justifies operative interference. Sometimes

the operation must be performed on a presumptive diagnosis of old pus-tubes, based mainly upon the patient's history and the existence of serious septic symptoms, with tenderness on abdominal palpation over the region of the tube and ovary. The uterus may be much too high in the abdominal cavity for a satisfactory pelvic examination of the uterine appendages.

There is often nothing peculiar in the technic of these operations. They differ, usually, in no respect from similar operations upon non-puerperal patients. The question of removing the uterus along with the tubes arises, however, rather more frequently than in the non-puerperal woman, on account of the infection of the endometrium or of persistent metrorrhagia. But in associated suppurative salpingitis, ovaritis, and infection of the connective tissue of the broad ligament, there is a modification of the ordinary technic, which is of vital importance. The tubes and the ovaries should be excised, the blood-vessels of the broad ligaments tied separately; the cut edges of the broad ligaments should be allowed to gape; the whole pelvic cavity should be filled with gauze and drained by a glass tube placed just posterior to the uterus. The dressings, sterile gauze and cotton, cover the tube and wound completely. They are not disturbed for twenty-four hours, when the tube is sucked out by a syringe. Twenty-four hours later the gauze is removed, the tube again sucked out and removed, after the rubber drainage-tube is slipped within it, to take its place. Through the rubber tube the pelvis is washed out daily with sterile water. Apparently most desperate cases may be saved by this technic.

Hysterectomy for Puerperal Sepsis.—Osterloh¹ says that Schultze was the first to advise hysterectomy in the treatment of puerperal sepsis. The indications for it as given by Schultze² are: There must be an active source of infection in the uterus which cannot be treated by way of the genital tract. (2) There must be no other imminent source of infection outside of the uterus. (3) There must be no probability of an extension of the infection outside of the uterus, as, for example, in more or less removed thrombi or emboli.

This plan at first received very little attention, but within recent years has been very widely discussed. There seems to be more or less a consensus of opinion that hysterectomy alone should only be performed in case the original indications of Schultze obtain. Thus Leopold³ believes that hysterectomy is indicated in puerperal infection only when all the symptoms indicate that the uterus alone is the situation and the actual source of the infection.

Fehling⁴ says that hysterectomy can rationally be recommended only if the intoxication or the infection is entirely limited to the uterus. He reports sixty-one cases with a mortality of 55.7 per cent.

¹Osterloh: "Beitrag zur Behandlung der puerperalen Sepsis," Münch. med. Wochenschr., 1902, No. 21, p. 894.

²Schultze, B. S.: "Amputation des corpus uteri mittels Laparotomie wegen Retention der Placenta und puerperaler Sepsis," Centralbl. für Gynäk., 1886, No. 47, p. 765.

³Leopold: "Die Hysterectomie in der Behandlung der puerperalen Infection," Centralbl. für Gynäk., 1902, No. 44, p. 1162.

⁴Fehling, H.: "Hysterectomie in der Behandlung der puerperalen Infection," Centralbl. für Gynäk., 1902, No. 44, p. 1162.

Treub¹ reports seven hundred and twenty-four cases of puerperal infection treated expectantly with thirty-four deaths. In only six of the fatal cases was the disease localized to the uterus, and the autopsies in two of these cases showed that hysterectomy would have been entirely useless.

Treub mentions thirty-six cases of total extirpations, of which fifteen were saved. He contrasts this result with that obtained through conservative treatment. More lives are lost than saved by a radical operation, to say nothing of the mutilation of the pelvic organs if the woman survives.

Bumm² says that hysterectomy will be successful in cases complicated by wounds of the uterus received during the induction of abortion or operative manipulations during labor. It will also be of service in case of gangrene of the uterus such as might be caused by the necrosis of a myoma or the retention within the uterus of fetal parts or large pieces of placenta.

v. Winckel³ says that to extirpate the uterus in every case of diffuse suppurative peritonitis simply because it is the starting-point of the trouble, without waiting to see if the patient is not materially improved by the removal of the exudate, is quite irrational, because by doing hysterectomy all of the infectious material is not by any means removed.

Norris⁴ quotes Valère Cocq as saying that hysterectomy is indicated when there is a grave toxemia and the uterus has in all probability become the chief entrance of the septic material, and, other means of treatment having failed, the patient is still strong enough to stand operation. These conditions are found in certain cases where the placenta has been retained and is undergoing decomposition and cannot be removed by the curet. In cases of suppurative metritis this is also true. In cases showing extensive involvements of the parametrium and adnexa, though they are often treated with ice and opium in the hope of avoiding an operation, the radical operation sooner or later is found to be necessary to save the life of the patient.

As may be seen, the removal of all the pelvic organs and structures that can be removed by hysterectomy is a subject which has created wide-spread discussion. Every physician who has seen many cases of puerperal infection during operations or post-mortem is aware that there are some in which the mere removal of infected tubes and ovaries, vaginal section and drainage, or the evacuation of pelvic abscesses through the abdomen cannot be expected to save the patient.

There would be left behind areas of infected and infiltrated broad ligaments that would communicate infection to the peritoneal cavity, there would remain foci of suppuration or infection in the uterine body that must surely spread to the peritoneum or must result in septic metastases, and the streptococcic invasion of

¹ Treub, H.: "Hysterektomie in der Behandlung der puerperalen Infection," *Centralbl. für Gynäk.*, 1902, No. 44, p. 1162.

² Bumm, E.: "Ueber die chirurgische Behandlung des Kindbettfiebers," *Referat in dem Centralbl. für Gynäk.*, No. 8, 1902, p. 219.

³ v. Winckel, F.: "Ueber die Kōliotomie bei der diffusen eitrigen puerperalen Peritonitis," *"Therapeut. Monatshefte,"* 1895, S. 178.

⁴ Norris, R. C.: "Progressive Medicine," Sept., 1904, p. 255.

the myometrium not infrequently is followed by necrosis of the uterus. The only hope for the patient in such cases lies in the entire removal of all infected areas, leaving behind in the pelvis a healthy, non-infected stump. To effect this result the excision of the uterus, the broad ligaments, the tubes, and the ovaries is required. In addition to these cases, there are others in which, if the tubes and ovaries must be excised, the uterus might be removed with advantage, on account of an infected endometrium or of persistent metrorrhagia. Fig. 416 is an example of such a case. The young woman from whom the specimen was removed had a double pyosalpinx following a criminal abortion. For seven weeks she had been bleeding persistently, and at intervals had a foul-smelling discharge. Although the body of the uterus was healthy and the endometrium alone was inflamed and infected, it was obviously wiser to remove at once all sources of the trouble rather than to excise the tubes and ovaries and then to treat separately at some trouble and risk an organ that had become entirely superfluous. There may also be such wide-spread suppuration and disintegration of the broad ligaments, with tubal inflammation, that it is easier to remove all the infected area, and to control hemorrhage, by a hysterectomy. Fig. 417 represents such a case. A pyosalpinx antedated conception. Labor



FIG. 416.—HYSTERECTOMY FOR PURULENT SALPINGITIS (Author's Case).



FIG. 417.—SUPPURATIVE CELLULITIS OF BROAD LIGAMENT; HYSTERECTOMY (Author's Case).

excited fresh inflammation. The infection spread through the tube downward through the connective tissue of the broad ligament, resulting in its partial destruction, in a thick infiltration at its base, and in an abscess between its layers, closely hugging the whole of one side of the uterine body. It was obviously impossible to remove the infected area without removing the womb as well. The operation, though undertaken under the most discouraging circumstances, was successful.

There can be no doubt as to the necessity of hysterectomy in the cases represented in Figs. 418 and 419. There were abscesses in the uterine wall, directly under the peritoneal envelop, about to break into the peritoneal cavity; one, indeed, did rupture during the operation. There was a septic ulceration at the placental sac, in one case so nearly perforating the uterine wall that by a light touch during the

operation the forefinger passed into the uterine cavity. There was also a pyosalpinx, in these cases, which, judging by the history, antedated or was coincident with impregnation. The operations saved the patients. In another successful hysterectomy for puerperal sepsis, the author found the womb completely ruptured at the fundus from tube to tube.



FIG. 418.—SUPPURATIVE AND ULCERATIVE METRITIS, SALPINGITIS; HYSTERECTOMY (Author's Case.)

The diagnosis of the injury had not been made. The operation was undertaken some weeks after labor, for what was thought to be an intraperitoneal abscess. Areas of suppuration were discovered, but the greater bulk of the inflammatory mass was exudate which had shut off the general peritoneal cavity from infection through the gaping uterine wound. In cases of streptococcic infection the whole uterus may be found so necrotic that its consistence is that of cheese.

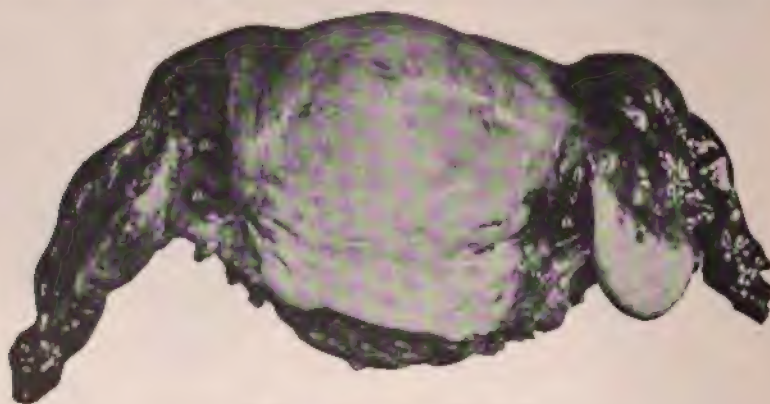


FIG. 419.—SUPPURATING METRITIS.
a, a, a, Abscess cavities. Hysterectomy two weeks after labor. Recovery.

No ligature holds in it and the uterine wall may be pinched through anywhere by the thumb and forefinger. One might as well expect a woman to live with a gangrenous coil of intestine in her abdomen as with such a gangrenous and necrotic uterus. She can only be saved, if at all, by a hysterectomy. It may also be necessary to remove the uterus in the puerperium to get rid of an infected fibromyoma,

as illustrated in Fig. 420. This uterus was removed on the fourth day of the puerperium, the patient's temperature having been 104° F. and the pulse 140. Streptococci were found in the interior of the tumor and there was general systemic infection, with phlebitis and septic pneumonia, but the woman recovered.

Indications for the Operation.—The indications for hysterectomy during puerperal sepsis are furnished by the condition of the pelvic organs when they are exposed to sight and touch after the abdomen is opened. The six conditions described above are the types calling for hysterectomy. It is not often possible to determine upon hysterectomy before the abdomen is opened, but it should be remembered that in any abdominal section for puerperal sepsis hysterectomy may be necessary. The surgeon, therefore, should be prepared for hysterectomy in every abdominal section for puerperal sepsis, but should rest content with the least radical measure that promises his patient safety. It may be sufficient to excise the cornua or the



FIG. 420.—SCHEMATIC FIBROMA REMOVED BY HYSTERECTOMY IN EARLY PUERPERIUM (Author's Case).

fundus. The operation that is quickest done and shocks the patient least is most successful, provided, of course, that it is adequate.

Technic of the Operation.—There are two points in which the technic of hysterectomy for puerperal sepsis may differ from the technic of the operation performed for other conditions. One of these points is the necessity often of doing pan-hysterectomy; the other is the necessity often of tying the ligatures in a broad ligament much thickened by inflammatory exudate or by ligating the blood-vessels separately so as not to include an infected mass in the ligature.

The author's preference is for amputation of the uterus, leaving as little cervix as possible, unless an examination of the cervix by a speculum shows septic ulceration or exudate upon it or in its canal. The reasons for this preference for amputation of the womb over pan-hysterectomy are that the former can be done more quickly, there is not the same anxiety about the cleanliness of the vagina, the suture

material is more certainly guarded from infection afterward, and there is less danger of cutting or ligating the ureters.

The thickened broad ligaments are often a source of serious embarrassment in placing and tying the ligatures around the uterine arteries. There is difficulty to contend with in the majority of operations. In some cases the inflammatory exudate within and below the ligature breaks down into pus, but an incision in the posterior vaginal vault evacuates the pus and usually secures an immediate disappearance of somewhat alarming symptoms. It may be necessary to do this as late as four weeks after the hysterectomy. Vaginal hysterectomy is usually unsuitable for cases of puerperal sepsis on account of the danger of clamping or ligating large masses of infiltrated and infected broad ligament, on account of the stiffened and adherent broad ligaments, which make downward traction on the uterus difficult or impossible, and because it is impracticable in a vaginal operation to explore the pelvis and abdomen for foci of infection at some distance perhaps from the pelvic organs.

Exploratory Abdominal Section for Puerperal Sepsis.—An exploratory incision should be made only in cases of suspected extraperitoneal pelvic abscess, to confirm one's suspicion, to be certain that none of the pelvic organs, especially the tubes, are diseased, and to determine the best situation for the incision that shall evacuate the abscess-cavity without contaminating the peritoneal cavity. This rule of practice would exclude exploratory abdominal section in cases with no physical signs of pelvic inflammation, but in which there is evident septic infection of a nature difficult to determine. There are possible exceptions to the rule, however, as in cases of suspected pyosalpinx without physical signs, owing to the high position of the recently emptied womb and of its appendages.

A typical case requiring exploratory abdominal section occurred in the practice of the author in a woman who had miscarried some weeks before she came under observation. She had lost over thirty pounds in weight, was bedridden, had night-sweats, high fever, profound prostration, and exacerbations of pain in the pelvis. On examination the usual symptoms of extraperitoneal pelvic exudate and suppuration were found on the right side. When the abdomen was opened, it was found that all the pelvic organs and the pelvic peritoneum were perfectly healthy. There was a large collection of pus between the layers of the right broad ligament, giving to this structure a dome-shape. The tube and ovary running over the top of the distended broad ligament were perfectly healthy and without a trace of adhesion or inflammation of any kind. With the abdomen opened it was easy to locate the level of the anterior duplication of the peritoneum. A mark was made on the skin an inch below this point, the abdominal wound was closed, an incision was made in the groin, and the pus washed out by douching. Sinuous tracts of suppuration were found by the finger running up the psoas muscle and down into the floor of the pelvis. Two drainage-tubes were inserted, one upward into the psoas muscle, the other downward into the pelvis. In the course of this woman's convalescence it was found advisable to make a counteropening in the

right lateral fornix of the vagina, and to pass a drainage-tube through from the opening in the groin to the vagina. In this way perfect drainage was established and the patient made a good recovery.

Cases of true extraperitoneal pelvic abscesses due to puerperal infection, and without intraperitoneal inflammation, are rare.

For a full discussion of this see Chapter IV, page 298, Vol. I. In two of my cases the suppuration was so evidently extraperitoneal that an abdominal section was dispensed with. An incision was made in the flank above the crest of the ilium and another in the groin above Poupart's ligament. A pint or more of pus was evacuated. In one case an abdominal incision was made for what was thought to be an intraperitoneal abscess. Before the incision was completed pus welled out of the uterovesical connective tissue. A large extraperitoneal abscess was found between the uterus and bladder. It was counterdrained through the anterior vaginal vault. Another case exactly similar was deliberately opened by an incision above the symphysis and below the anterior reduplication of the peritoneum. All these cases of extraperitoneal suppuration recovered.

CHAPTER XXX.
EXTRAUTERINE PREGNANCY.

BY J. WHITRIDGE WILLIAMS, M.D.

In extrauterine pregnancy the fertilized ovum is arrested and undergoes more or less complete development at some point between the follicle in which it originated and the uterus. The term "ectopic gestation," which is sometimes used synonymously with it, has a somewhat broader meaning, and includes not only the usual varieties of extrauterine pregnancy, but also the cases in which the ovum is implanted in the uterus outside of its normal cavity.

This article is limited to the consideration of the typical forms of extrauterine gestation, and those who are interested in pregnancy in abnormal uteri are referred to the exhaustive monograph of Kehrer, and to the section by Werth in Winckel's "Handbuch der Geburtshülfe."

I shall not attempt in this place to trace the history of the affection, but refer those who are interested in it to the monographs of Campbell, Hecker, Parry, Tait, Webster, and Werth, in which it is treated in detail.

Frequency.—Up to 1883, when Tait first operated for a ruptured tubal pregnancy, the condition was important chiefly from a pathologic point of view, but since then it has attained a markedly practical interest. This is manifested by the constantly increasing literature upon the subject. Henning, in 1876, stated that extrauterine pregnancy was so rare an affection that even the directors of large obstetric institutions might never see a case, and Parry in the same year was able to collect only 500 cases from the entire literature; while at the present time such a task would prove practically impossible.

The increase in the frequency of the affection is likewise borne out by the experience of individual operators. Thus, Wormser stated that 40 cases were observed in the Berne clinic during the five years ending with 1898, as compared with 14 cases in the fourteen preceding years; and Küstner saw 105 cases in Breslau in the five years ending with 1899, but only 9 during his entire experience in Dorpat. A corresponding increase has been noted in nearly all large clinics, and Noble states that from 3 to 4 per cent. of all his laparotomies are performed upon extrauterine pregnancy cases. Indeed, Ahlfeld seems to be the only prominent gynecologist who has not had a similar experience, as he stated in 1898 that he had seen but two cases during sixteen years' activity at Marburg and Giessen.

This increased frequency is, however, to some extent more apparent than real, and is due partly to greater proficiency in diagnosis and partly to the fact that the great frequency with which the abdomen is now opened affords abundant oppor-

tunity for the recognition of many conditions which previously escaped discovery. At the same time it seems probable that there has been an actual increase in its incidence, as a result of the greater prevalence of gonorrhea and the physical degeneration of the poor in large cities.

ETIOLOGY.

Unfortunately concise and definite statements cannot be made concerning the etiology of the condition, but instead a large number of explanations of greater or less plausibility have been advanced, which may be divided into two groups for more convenient consideration: (1) Conditions which interfere mechanically with the downward passage of the ovum. (2) Physical and developmental conditions which favor decidual formation in the tubes.

CONDITIONS WHICH INTERFERE MECHANICALLY WITH THE DOWNWARD PASSAGE OF THE OVUM.

Peritoneal Adhesions.—One of the earliest explanations for the causation of extrauterine pregnancy was sought in peritoneal adhesions, which bound down and constricted the tubal lumen. According to Hennig, Fritze in 1779 was the first to direct attention to this condition, but the names of Virchow, Hecker, and Rokitansky are usually associated with it. These authors believed that the adhesions cause the arrest of the ovum by compressing the lumen of the tube, or by interfering with its peristalsis—a view which has still some adherents, and is occasionally verified at operation or autopsy.

Tubal Polypi.—A considerable number of observers, among whom may be mentioned Leopold, Breslau, Beck, and Wyder, have reported cases in which they believed that polypi projecting into the lumen of the tube caused the arrest of the ovum. It would appear, however, that only the cases of Beck and Wyder are at all convincing, as only in them were the polypi situated between the fetal sac and the uterus. Moreover, it is quite possible, as Ahlfeld has pointed out, that even they had nothing to do with the arrest of the ovum, but were merely secondary decidual outgrowths. De la Faille considered that a similar explanation might be invoked for one of his cases of interstitial pregnancy, as he found the proximal extremity of the tube occluded by a portion of the uterine decidua.

Tumors of the Tube Wall.—Petit, Dührssen, and others have described myomata in the tube wall, which they believed so compressed its lumen as to interfere with the passage of the ovum; while in other instances tumors arising from surrounding organs are believed to have played a similar part.

Salpingitis.—Schroeder in 1877, but more particularly Tait, a few years later, advanced the theory that the most frequent cause of tubal pregnancy was to be found in endosalpingitis. These authorities held that fertilization normally occurred in the uterine cavity, and was facilitated by the fact that the ciliary current was directed from below upward in the uterus and from above downward in the tubes, so that

the spermatozoa were readily carried upward to the fundus, but were prevented from gaining access to the tubes. Accordingly, they supposed if the cilia of the tube had been destroyed as a result of salpingitis, that there would no longer be any obstacle to the ascent of the spermatozoa; while at the same time the downward passage of the ovum would be rendered very difficult.

Recent work, however, has demonstrated the fallacy of these arguments. In the first place, Hofmeier and Mandl have shown that the ciliary current is directed from above downward from the fimbriated end of the tubes to the internal os, and therefore the spermatozoa are obliged to work against the current from the time they pass the cervix. More important is the fact that experiments upon animals and a few observations upon human beings show that a few hours after copulation spermatozoa can be found in the lateral portion of the tubes, and even upon the surface of the ovary. Accordingly it would appear that the lateral end of the tube may be regarded as a receptaculum seminis, and that conception normally occurs in that location or upon the surface of the ovary. Consequently every pregnancy is extrauterine in its early stages, and the problem to be solved is not how the ovum and spermatozoa meet in the tube, but why the fertilized ovum usually descends into the uterus.

Tait's theory has found many adherents, but careful study of the specimens obtained at operation appears to show that it is without foundation in the majority of cases. In nearly every specimen which I have examined I have been able to demonstrate the presence of cilia in the pregnant tube, and similar observations have been made by Hofmeier and Zedel, the latter having observed them in motion in three out of the four specimens which he examined immediately after operation. This, however, does not demonstrate that salpingitis plays no part in the production of extrauterine pregnancy.

The views of Schroeder and Tait were promptly accepted by most authorities, and at the present time are still held in a modified way by many writers, among whom may be mentioned Martin, Dührssen, Fehling, Mandl and Schmidt, Ott, Küstner, Petersen, Runge, and others. The etiologic connection is borne out by two facts: first, that one is able to elicit a history of previous inflammatory trouble in the majority of cases, and, second, that in many instances careful histologic examination reveals traces of past or present inflammation, which frequently involves both tubes.

Following the demonstration that Tait's original theory was incorrect, great difficulty was experienced in formulating a satisfactory explanation for the fact that salpingitis facilitated the occurrence of tubal pregnancy; and most writers were obliged to be content with merely demonstrating that inflammatory lesions were present in a certain percentage of their cases. Thus, Ott and Petersen could elicit an inflammatory history in all of their cases, Runge in most of his, while Mandl and Schmidt, and Dührssen stated that 66 and 68.7 per cent. of their patients had suffered from gonorrhea. Negative evidence was offered by Ahlfeld, who believes that the infrequent occurrence of tubal pregnancy in his experience

may be explained by the fact that his material comes from a country district where gonorrhea occurs but rarely.

In 1902 Opitz found definite inflammatory lesions in 15 out of 23 specimens from Olshausen's clinic, and in every instance, whether such lesions were present or not, noted that the tips of many of the folds of the mucosa had become fused together, so that the microscopic sections frequently presented the cribriform appearance characteristic of follicular salpingitis. Moreover, he found similar lesions in the non-pregnant tube, wherever it was available for examination.

He held that such a condition afforded a very satisfactory explanation for the arrest of the ovum, as he assumed that some of the canals inclosed between the adherent folds ended blindly at one end, but communicated freely with the main lumen at the other. Accordingly, it would only be necessary for the fertilized ovum to enter one of these cul-de-sacs in order to be arrested, and thus lead to the development of a tubal pregnancy. Similar observations have been made by Micholitsch and others, and can be confirmed by any observer.

This explanation has been enthusiastically accepted by Werth, who considers it of almost universal application. It is interesting to note that he described a similar condition in his monograph of 1887, but did not recognize its significance. I have frequently made the same observation, and while I consider that such a condition may cause the arrest of a fertilized ovum, I am inclined to agree with Kermauner that we should hesitate before giving it a too general acceptance.

Diverticula from the Lumen of the Tube.—In 1891 Landau and Rheinstein and myself demonstrated the presence of epithelial canals in the muscular wall of the tube, and showed by means of serial sections that one end communicated with its main lumen, while the other ended blindly. We both suggested that a fertilized ovum might occasionally become arrested at the blind end of such a structure and thus give rise to a tubal pregnancy; and Landau and Rheinstein described a specimen which they believed demonstrated such a mechanism.

For some years I believed firmly in this mode of origin, and thought that I had studied a number of specimens which demonstrated its correctness. These were cases of early tubal pregnancy, in which the product of conception lay in the muscular wall of the tube, entirely outside of its lumen. Further study, however, has led me to believe that my conclusions were erroneous, and that the findings upon which they were based in reality represent the normal mode of implantation of the ovum in the tube, and are entirely independent of the existence of diverticula. This question, however, will be considered more in detail in the paragraphs devoted to the anatomy of the pregnant tube. At the same time I do not wish to deny the possibility of the arrest of an ovum in such structures, as I believe that it occasionally occurs.

During the past few years Goebel, Opitz, Micholitsch, Fellner, and others have devoted considerable attention to this subject, and have shown that diverticula from the lumen of the tube are of frequent occurrence, and hold that they play an important part in the etiology of tubal pregnancy. In fact, Fellner states that they are

the usual cause of the condition, and believes that its non-occurrence in the lower animals is to be attributed to the absence of such structures.

It is generally considered that such diverticula are congenital in origin and represent abortive attempts at the formation of accessory tubal ostia. The investigations of Hoehne, however, show that such is not always the case; as he has been able to demonstrate, in one specimen at least, that they may result from a secondary extension of the tubal epithelium into the cavities of small intramural abscesses which have ruptured into the lumen of the tube.

In exceptional instances serial sections through the tubes demonstrate the presence of abnormal lumina. These may vary from canals which extend almost its entire length, and represent an abortive attempt at the formation of an accessory tube, to processes of varying length which extend from the lumen of the tube and continue parallel to it for a certain distance, and then either rejoin it or end blindly. I have studied one specimen in which the ovum was probably arrested in such a structure, while Henrotin and Herzog, and Franqué and Garkisch have described cases in which such a mode of origin was conclusively demonstrated.



FIG. 421.—PREGNANCY IN ACCESSORY TUBAL OSTIUM (Henrotin and Herzog).

A, Small accessory ostium; B, opening of pregnant ostium; C, blind end of same; D, blood-clot containing remnants of ovum.

Occasionally accessory tubal ostia may play a part in the etiology of the affection, and Sängér has reported a case in which the ovum gained access through such a structure to a tube whose fimbriated extremity was firmly occluded. Frequently what appears at first glance as an accessory ostium does not communicate with the lumen of the tube, but merely represents a small cul-de-sac, in which the fertilized ovum may occasionally be arrested, as was conclusively demonstrated in a specimen described by Henrotin and Herzog (Fig. 421).

In this connection it may be interesting to refer to the cases recently reported by Hofmeier and by Potocki. The former removed the left tube, whose uterine end was the seat of a ruptured pregnancy; and six months later again operated upon the same woman for intra-abdominal hemorrhage. To his great surprise, he found an early pregnancy arising distal to the ligature upon the stump of the amputated tube. In Potocki's case pregnancy followed the removal of the left tube and ovary and the excision of a myoma from the left side of the uterus. The fetal sac was attached beneath the left cornu and communicated with the uterine cavity, while the tubal stump from the previous operation was impervious. After careful study the author concluded that the ovum had become arrested, at the outer end of a fistulous tract, which had followed the removal of the myoma, and considers that the nearest approach to a similar condition was afforded by the celebrated case of Lecluyse.

Congenital Narrowing of Tubal Lumen.—Runge in 1904, and Franqué and

Garkisch in 1905, invoked such a condition as an occasional etiologic factor. In Runge's case the lumen of the tube proximal to the pregnancy was reduced to one-twentieth of its normal caliber.

Persistence of Fetal Convolutions of the Tube.—Ever since Freund and Schrober had demonstrated the part which persistence of the convolutions, which characterize the tube in early life, may play in the production of tubal diseases, a certain number of authors have held that such a condition may occasionally give rise to extrauterine pregnancy, either by constricting the lumen of the tube or by interfering with its peristalsis. This condition has been invoked as an etiologic factor by Abel, Goebel, Kreisch, and others.

Puerperal Atrophy of the Tube.—Dührssen pointed out that some of his cases of extrauterine pregnancy occurred within one year or less after a normal labor, and in two instances while the mother was still suckling her child. In such instances he believes that a puerperal atrophy of the muscularis of the tube had so impaired its peristalsis as to interfere with the downward propulsion of the ovum, and fortifies his assertion by an illustration in which the tube presents a markedly atrophic appearance.

External Migration of the Ovum.—Every one who has carefully studied the anatomic conditions in a considerable number of extrauterine pregnancy specimens has noted the frequent occurrence of external migration of the ovum: that is, finding the corpus luteum in one ovary and the pregnancy in the opposite tube. I have noted it in at least one-fourth of my cases, but am unable to state whether it is peculiar to tubal pregnancy, since comparatively few opportunities occur for ascertaining how frequently it occurs in normal uterine pregnancy.

Attention was first directed to this condition by Kussmaul, while Schrenck, Küstner, Kermauner, and others have especially insisted upon its incidence in extrauterine pregnancy. Moreover, Sippel has pointed out that occasionally under such circumstances the transit may be delayed so long that the ovum undergoes such development as to interfere with its passage through the narrower parts of the tube.

Hitschmann and Lindenthal upon purely theoretic grounds advanced a somewhat similar explanation for cases not associated with external migration.

Obstruction by Twin Ova.—In view of the relative frequency of combined tubal and uterine twin pregnancy, of which Parry collected 23 in his 500 cases of extrauterine pregnancy, Barnes supposed that the arrest of one ovum in the tube might be attributed to the two ova mutually interfering with one another, so that one was retarded until it had become too large to pass on to the uterus.

This view, however, possesses only a historic interest, as the vast literature of recent years shows that combined pregnancy occurs far less frequently than Parry thought. Moreover, in several of the cases, which have been carefully investigated, such an explanation could not be considered, for the reason that the presence of corpora lutea in each ovary indicated that the two ova had descended separate tubes.

PHYSICAL AND DEVELOPMENTAL CONDITIONS WHICH FAVOR DECIDUAL FORMATION IN THE TUBES.

This theory owes its origin to Webster, who could not accept any of the large number of theories which had been advanced up to this time. After considering the embryology of the genital tract, and emphasizing the well-known fact that both the tubes and the uterus were originally derived from the Müllerian ducts, he stated that there was no inherent reason why an ovum should not become implanted upon the upper as well as upon the lower part of this canal. Consequently, the only explanation which he could offer for its infrequent occurrence was that the decidual reaction which occurs so promptly and decidedly in the uterus, in the presence of a fertilized ovum, is usually lacking in the tubes. Such a reaction he considered a reversion to an earlier type, and therefore a sign of degeneracy.

This view was soon indorsed by a number of writers, among whom may be mentioned Pantellani, Mandl and Schmidt, Wormser, and Moericke, but without anatomic data. Notwithstanding the fact that most recent investigators believe that the decidua is entirely lacking or only comparatively slightly developed in the pregnant tube, Webster still holds to this theory. In 1904, when describing an undoubted case of ovarian pregnancy, he stated that he did not believe that implantation could occur outside of the Müllerian tract; and, in order to bring his observation into harmony with such a theory, he contended that fragments of Müllerian tissue must have become incorporated into the ovary.

More or less closely connected with Webster's theory is the view advanced by Sippel, who, as stated above, noted external migration of the ovum in a considerable proportion of his cases. He believes that a certain time must elapse after fertilization before a decidual reaction can occur, and that the ovum has usually reached the uterus before this happens; but that in external migration the time consumed by the ovum in making the transit through the peritoneal cavity may be sufficient to allow the tube to exhibit such a reaction.

From what has just been said, it is apparent that there is no lack of theories concerning the etiology of extrauterine pregnancy, and the question which we have to consider is which of them is correct, or whether any one is of universal application.

Theoretically it would appear that certain of the mechanical conditions mentioned above must frequently play a part in the production of the affection. On the other hand, it must be admitted that diverticula from the lumen of the tube and the so-called follicular salpingitis are frequently noted, while tubal pregnancy occurs but comparatively rarely.

The greatest blow, however, which these theories have suffered is from the experimental work of Tainturier, and Mandl and Schmidt. These investigators applied ligatures to various parts of the genital tract of rabbits shortly after copulation. When the ligature was applied to one uterine cornu, some distance below the tubal opening, ova developed distal to the ligature, as well as in the normal horn. Where both cornua were ligated, ova developed only distal to the ligatures; on the other

hand, when the ligatures were applied to the uterine end of the tubes, extrauterine pregnancy did not develop, although dead ova could be demonstrated in them. In a series of control experiments only one tube was ligated, when the same result was obtained on that side, while the other horn contained normal embryos.

These experiments apparently show that, in the rabbit at least, some other factor than mere mechanical interference with the downward passage of the ovum is essential to the production of tubal pregnancy, and this Mandl and Schmidt sought in a preliminary decidual reaction. The fact, however, that the recent work upon the anatomy of the pregnant tube shows that the decidual formation is never abundant, and is frequently altogether absent, would militate strongly against such a view. The only positive experimental work along these lines was reported by Nuck many years ago, but it is probably open to the objection that he did not distinguish carefully between the uterine cornua and tubes in the lower animals.

The idea that the affection is a sign of degeneration or reversion, while extremely interesting and to a certain extent borne out by facts, cannot be accepted as a universal solution for the problem; for in many instances the condition occurs in perfectly healthy women who live amid the best surroundings. Moreover, its great rarity in the lower animals also speaks against such a view, and Bland-Sutton states that in his large experience in the zoölogical gardens of London he has never met with tubal pregnancy in animals, and believes that all such cases recorded in the literature are due to uterine rupture, or to confounding the uterine cornua with the tubes. This statement, however, appears somewhat too radical, as Waldeyer has reported an undoubted case in an ape.

In view of the considerations adduced, it is apparent that there is no universal cause for extrauterine pregnancy. In many instances the arrest of an ovum in a crypt resulting from follicular salpingitis, or in a diverticulum from the lumen of the tube, may afford a satisfactory explanation; though in a certain proportion of cases even the most careful history of the patient and thorough microscopic examination of the specimen will fail to reveal a tangible cause for the condition, which will then remain as great a problem to us as to our predecessors.

CLASSIFICATION.

The fertilized ovum may be arrested at any point on its way from the follicle in which it originated to the uterine cavity, and accordingly may undergo development in either the ovary or the tube, giving rise to ovarian or to tubal pregnancy. There is, however, considerable doubt as to whether it can become implanted upon the peritoneum and lead to a primary abdominal pregnancy. We shall consider each of these groups in detail.

OVARIAN PREGNANCY.

Ovarian pregnancy was first described by Mercerus in 1614 and by St. Maurice in 1682, after which it was generally recognized, and was included by both Bianchi and Boehmer in their classifications of extrauterine pregnancy.

Its existence was generally admitted until 1835, when Velpeau stated that it was impossible to adduce conclusive evidence of the ovarian nature of any of the cases which had been described up to that time. Likewise in 1847 Mayer, a pupil of Bischoff, positively denied the possibility of its occurrence, and held that all cases which had been described as such had been incorrectly interpreted. Similar views were also expressed by Allan Thompson and Pouchet. Their skepticism was probably fully justified at the time, as many of the cases collected by Campbell and Collet Y. Gurgui were simple dermoid cysts.

On the other hand, all German authorities, with the exception of Mayer, have admitted its possibility, and Kiwisch in 1851 described a case which he considered conclusive.

Prior to 1900 the possibility of the occurrence of ovarian pregnancy was almost universally denied by English writers, among whom may be mentioned Tait, Webster, Cullingworth, Bland-Sutton, and Taylor. Indeed, as far as I can ascertain, only three cases were reported in England during the nineteenth century; namely, two by Granville in 1834, and one by Oliver in 1896. In this country most writers have followed the English authorities, although Parry admitted its existence, and not a few operators have reported doubtful cases; but it was not until 1902 that Thompson demonstrated a perfectly conclusive specimen.

At the present time no one doubts the possibility of ovarian pregnancy, and even such critics as Bland-Sutton and Webster have been compelled to admit that their previous skepticism was not justified.

Up to 1878 there existed no definite criteria by which such cases could be judged, and many specimens were described as ovarian pregnancy which had no claim to such a title. In that year, however, Spiegelberg reported what he believed to be a conclusive case, and formulated certain conditions which he held must be fulfilled in order to justify such a diagnosis. He demanded: (1) that the tube on the affected side be intact; (2) that the fetal sac occupy the position of the ovary; (3) that it be connected with the uterus by the ovarian ligament; and (4) that definite ovarian tissue be found in its wall. When judged by these criteria, the majority of cases which had been described up to his time were found wanting, and subsequent investigation has shown that a number of cases which he considered conclusive are likewise open to very considerable doubt.

Werth, on the other hand, maintains that Spiegelberg's criteria are too rigid, and that their application would rule out many specimens concerning whose origin there is but little doubt. Accordingly, he states that one should consider as ovarian any fetal sac which is connected with the uterus and broad ligament in such a manner as to demonstrate its adnexial origin, when it can also be clearly shown that the tube, including the fimbria ovarica, takes no part in its formation, provided that the possibility of pregnancy in an accessory tube can likewise be excluded.

I cannot accept Werth's teachings, as I feel that their general adoption would lead to many cases being described as ovarian pregnancy which have no claim to be designated as such. Accordingly I consider it advisable to adhere to Spiegelberg's

criteria, with the still further proviso that ovarian tissue must be demonstrated not only at one point, but in several portions of the sac wall, tolerably far removed from one another. To my mind, this modification is necessary from the fact that in many cases of tubal and broad ligament pregnancy the ovary may become flattened out and incorporated into the sac wall to a considerable extent, and thus lead to an erroneous diagnosis.

Of course, it may be urged that such rigid criteria may occasionally exclude from consideration certain cases in which the characteristic histologic features of the ovarian tissue have become obliterated, just as frequently occurs in large ovarian cystomata. Such an objection may be justified, but I consider that the interests of science will be better served by excluding an occasional case, rather than by reporting large numbers of doubtful cases, such as crowd the literature at present.

Owing to the omission of careful microscopic examination these criteria are fulfilled in comparatively few of the reported cases, and consequently one is obliged to classify as probable or highly probable a number of cases which were previously described as positive. As far as possible, I have gone over the cases of ovarian pregnancy reported in the literature up to July, 1906, and divided them into four groups: positive, highly probable, fairly probable, and doubtful, according to the extent to which the above-mentioned criteria are fulfilled. At the same time I must admit that such a classification is purely arbitrary, and is open to criticism, as it is often impossible to form a correct estimate of a specimen from a written description, especially when it is unaccompanied by illustrations. Accordingly while the number of cases classed as positive and highly probable is small, the classification errs on the side of accuracy.

I have classified thirteen cases as positive, all of which were carefully described and studied microscopically; namely, those of Gottschalk (1893), Ludwig (1896), Kouwer and Tussenbroek (1899), Croft (1900), Anning and Littlewood (1901), Robson (1902), Franz (1902), Thompson (1902), Mendes de Leon and Holleman (1902), Micholitsch (2 cases) (1903), Boesebeek (1904), Webster (1904).

The cases of Gottschalk and Ludwig had gone to full term. In the former the pregnancy had become converted into a lithopedion and had been carried for thirty years before its removal; while in the latter the condition was associated with intra-uterine pregnancy, which terminated spontaneously. Several days later Ludwig performed laparotomy successfully, and removed a living child and the gestation sac.

In none of the other eleven cases had the pregnancy progressed beyond the fourth month, and all the specimens were most carefully described. In the cases of Tussenbroek, Anning and Littlewood, and Thompson the fetus was still within the ovary; in Croft's case it was in the abdomen, but connected with the interior of the ovary by the umbilical cord; while in Robson's case it had escaped into the peritoneal cavity. In the remaining specimens no trace of a fetus could be discovered, but the ovary contained a blood-stained mass of tissue in which chorionic villi and fetal elements could be positively demonstrated.

As highly probable I have classified seventeen cases. In many instances there

is practically no doubt concerning the nature of the specimens, but unfortunately some had not been examined microscopically, others had been preserved so long that accurate differentiation of tissue was out of the question, while in a third group the description was too brief to permit accurate judgment. In nine cases the pregnancy had not progressed beyond the fourth month: those of Granville, Hein, Uhde, Gottschalk (1886 and 1902), Schenck, Frank, Simon, and Fütth. In the other eight cases it had advanced to or beyond term—Walter, Spiegelberg, Leopold, Küstner-Fick, Herzfeld, Martin, Larsen, and Doche.

Five cases may be designated as probable, namely, those of Patenko, Puech, Geuer, Gilford, and Toth. The first four were from the early and the last case from the later months of pregnancy. Only the specimens of Patenko and Toth were examined microscopically, but in neither instance were the findings conclusive.

On the other hand, the evidence in favor of the ovarian nature of the specimens described by Hecker, Willigk, Benicke, Mann, Sängner, Wyder, Winckel, Oliver, Bandel, Lumpe, and Kantorowicz is so imperfect that I consider them as doubtful.

It is interesting to note that in eleven of the thirty-five cases which I have designated as positive, highly probable, or probable, the pregnancy went on to full term, and in not a few instances gave rise to lithopedion formations, which had been carried for years before removal. This would appear to indicate that the ovary can accommodate itself more readily than the tube to the growing pregnancy. At the same time, rupture at an early period is the usual termination, as is shown by the fact that eleven of the thirteen positive cases had not progressed beyond the fourth month.

It is important to bear in mind that the pregnancy may be destroyed at an early period, without rupture, and give rise to a tumor of varying size, consisting of a capsule of ovarian tissue inclosing a central mass made up of a blood-clot and chorionic villi, and may or may not contain an amniotic cavity, as in the specimens of Mendes de Leon and Webster. Such observations make it appear probable that a certain proportion of ovarian hematomata may actually represent the remains of an early pregnancy, but such a diagnosis should not be considered unless microscopic examination shows the presence of characteristic chorionic villi.

According to Leopold, ovarian pregnancy results from the fertilization of the ovum before its escape from the Graafian follicle. Moreover, he believes when several follicles mature at the same time, that a deeply lying one may rupture into a more superficial one without the escape of its ovum, which may be fertilized by spermatozoa entering through the superficial follicle. Such an occurrence would afford a satisfactory explanation for a pregnancy occupying the central portion of the ovary. Anatomic evidence in favor of intrafollicular fertilization is also afforded by the fact that several investigators, following the example of Tussenbroek, have demonstrated corpus luteum cells about the periphery of the ovum.

In ovarian pregnancy the ovum itself and its mode of implantation do not differ essentially from that observed in the uterus, except that a definite decidua is lacking, so that the fetal ectoderm invades the ovarian stroma directly and opens up the

blood-vessels. This lack of decidual tissue has been commented upon by every recent investigator, with the exception of Webster; and even in his specimen there is a strong possibility of confusion between fetal and maternal cells.

TUBAL PREGNANCY.

This is by far the most frequent variety of extrauterine pregnancy, and according to many English and American writers the only form with which we have to deal.

The ovum may be arrested at any point in the Fallopian tube, and, depending



FIG. 422.—UNRUPTURED AMPULLAR PREGNANCY, FOUR MONTHS.

upon its point of implantation, we distinguish between ampullar, isthmic, and interstitial pregnancy. Occasionally implantation may occur about the fimbriated extremity, and very exceptionally even upon the fimbria ovarica. From these primary forms certain secondary varieties occasionally develop, and will be considered later.

According to Rosenthal, interstitial pregnancy is by far the least frequent variety, occurring in less than 3 per cent. of the 1324 cases which he collected from the literature. Weinbrenner states that only 16 undoubted cases had been described up to 1885, which had increased to 35 in 1904; while Werth did not encounter a single example in 120 operations for extrauterine pregnancy. Moreover, Doran has stated

that there are only six specimens of interstitial pregnancy in the museums of London, as compared with almost countless numbers of the other varieties.

The statements as to the relative frequency of the isthmic and ampullar forms of tubal pregnancy vary greatly. Thus, Mandl and Schmidt contend that the former occurs more frequently, while Martin and Orthmann hold the opposite view, which is confirmed by my own experience.

Mode of Implantation of the Ovum.—Until the appearance of Graf Spee's work upon the implantation of the ovum in the guinea-pig, and the description by Peters of a very young human ovum embedded in the uterine mucosa, our views upon the subject were quite erroneous and based upon purely theoretic considerations. Prior to that time it was generally taught that a well-developed decidual formation was essential to the normal embedding of the ovum, and that in the tube, as well as in the uterus, a definite decidua vera, serotina, and reflexa were formed.

Peters' specimen, however, demonstrated that even in the uterus, a definite decidua is not necessary, as it clearly showed that the ovum had burrowed down into the depths of an edematous endometrium, whose stroma cells had not yet assumed a characteristic decidual appearance.

Moreover, as the ovum was completely shut off from the uterine cavity, it was apparent that the decidua reflexa could not have been formed, as was previously believed, by an upgrowth from the decidua vera, but rather that it had resulted from a cleavage of the portion of decidua immediately above the ovum.



FIG. 423.—ISTHMIC PREGNANCY.
Rupture ten days after last menstrual period.

This work, which has completely revolutionized our conception of the implantation of the ovum in the uterus, as well as of the development of the placenta, has been shown to apply equally well to the tube, although certain of its anatomic peculiarities usually necessitate a different outcome.

Even before the appearance of Peters' work it had become apparent that the old views could not be accepted in their entirety as far as tubal pregnancy was concerned. Thus, Bland-Sutton in 1891, and Füh and Griffiths a few years later, pointed out that the decidual reaction in the tube was nothing like so extensive as was generally believed; while Kühne, Aschoff, and Kreisch in 1899 cast grave doubts upon its existence, and contended that the cells which were usually described as decidual were really derived from the fetal trophoblast. Moreover, beginning with Rokitansky a certain number of investigators had been very skeptical concerning the development of a typical decidua reflexa in tubal pregnancy.

The ovum may become arrested at any portion of the tube, and according to Werth its implantation may be of the columnar or intercolumnar variety. In the former, which is of very rare occurrence, the ovum becomes attached to one of the folds of the mucosa, while in the latter it becomes implanted at the peripheral part of the lumen in a depression between two folds.

In either event the ovum does not remain upon the surface, but at once makes its way through the tubal epithelium and comes to lie in the tissue just beneath it. By this time its periphery is made up of a capsule of rapidly proliferating ectodermal cells—the trophoblast. These cells rapidly invade the surrounding tissues, and, as the tube does not possess a submucosa, almost immediately come in contact with the underlying muscularis, and make their way between its fibers.

The trophoblastic cells not only possess markedly invasive properties in virtue of their rapid proliferation, but also exert an erosive action upon the surrounding maternal tissue. As a consequence many of the muscle cells are destroyed and undergo fibrinous degeneration, while the blood-vessels in the vicinity are opened up by the invading trophoblast and by the escape of their contents give rise to a large number of spaces of varying size filled with blood, which lie entirely within the trophoblast, or between it and the surrounding maternal tissue.

This represents the earliest stage in the formation of the intervillous spaces and the placental circulation.

At the same time, fetal mesoderm grows down into the masses of trophoblast which bound the blood-spaces, and converts them into rudimentary chorionic villi, which possess a core of stroma and a periphery made up of many layers of fetal ectoderm. As the process goes on, these rudimentary villi gradually assume the arborescent form characteristic of fully developed chorionic villi, which then consists of a connective-tissue stroma covered by two layers of epithelium—Langhans' layer within and syncytium without.

Until definite villi have become developed, it would seem that the entire fetal

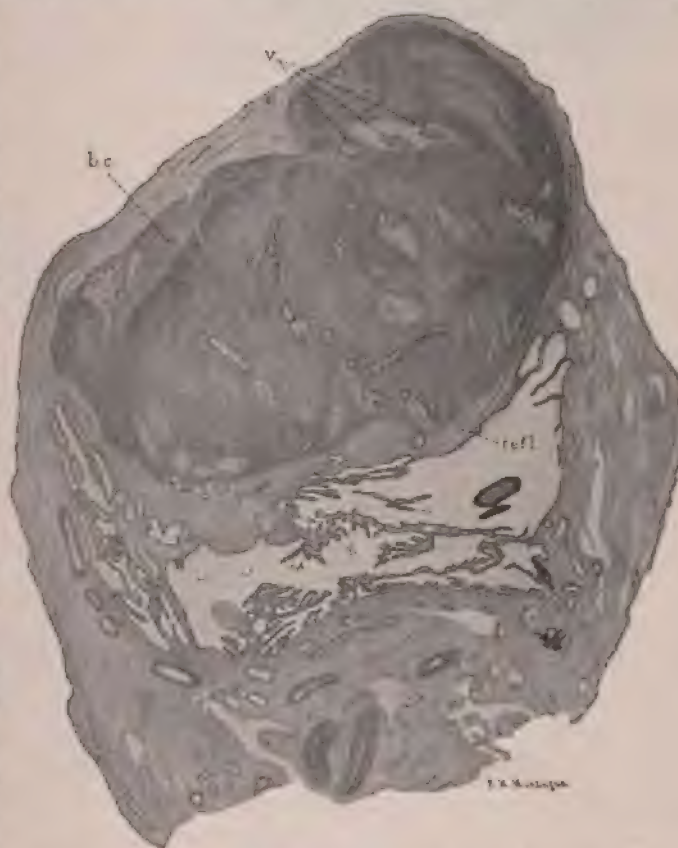


FIG. 424.—EARLY TUBAL PREGNANCY, SHOWING OVUM EMBEDDED IN WALL OF TUBE OUTSIDE OF LUMEN. X 6.

b. c., Blood-clot; v., chorionic villi; refl., pseudo-reflexa.

ectoderm possesses invasive and erosive properties, but afterward such action becomes restricted to the groups of cells which serve to attach the tips of the larger villous stems to the maternal tissue.

In the usual or intercolumnar mode of implantation the ovum, as soon as it penetrates the epithelium, it comes to lie in the tube wall outside of its lumen, from which it is separated by a layer of tissue of varying thickness—the capsular membrane or pseudo-reflexa. Fig. 424 gives a very good idea of intramural embedding of the ovum. In the very rare columnar mode of implantation the ovum lies in the interior of a fold of mucosa, and, except at its base, is surrounded on all sides by tubal mucosa, and has but small room for expansion.

As soon as I became acquainted with Peters' views concerning the mode of implantation of the ovum in the uterus, I felt convinced that exactly the same process occurred in the tube, and each additional specimen of early tubal pregnancy which I have studied has served to confirm my impression. When considering the question of the arrest of the ovum in tubal diverticula, I stated that further study had convinced me that many specimens, which I once thought afforded satisfactory proof of such an occurrence, should be regarded as excellent examples of the normal process of intramural embedding of the ovum. That I do not stand alone in this belief is shown by the fact that nearly every investigator who has studied the matter in recent years has arrived at the same conclusion. And I need only mention that it is indorsed by Füh, Griffiths, Aschoff, Kühne, Petersen, Andrews, Couvelaire, Lockyer, Werth, Pfannenstiel, Kromer, Voigt, Kermauner, Heinsius, Berkeley and Bonney, Wallgren and many other observers to indicate how general has been its acceptance.

The further development of the pregnancy depends in great part upon the portion of the tube in which implantation has occurred. When in the ampulla, the growing ovum pushes forward its capsular membrane into the tubal lumen, and the latter may eventually become so compressed as to form a mere crescentic slit, whose walls are almost in apposition. If the course of the pregnancy is not interrupted, the capsular membrane may fuse with the neighboring mucosa, so that eventually all trace of the lumen may disappear in the immediate vicinity of the pregnancy. On the other hand, when implantation occurs in the isthmus, and particularly in the portion immediately adjoining the uterus, the small size of the lumen precludes the possibility of such expansion, and as a consequence the ovum invades the tube wall peripherally to the lumen, so that the latter may eventually become almost completely separated from the underlying muscularis and surrounded by fetal tissue and chorionic villi (Fig. 425).

Decidua.—As has already been indicated, it was formerly held that a typical decidua vera and serotina were developed in every case of tubal pregnancy; and it was not until the work of Bland-Sutton in 1891, and particularly of Kühne and Aschoff in 1899, that its existence was seriously doubted. The last-named investigators, however, pointed out that the cells which had been previously described as decidual were of fetal origin and represented descendants of the original trophoblast, and contended that it was very questionable whether a decidual reaction

occurred at all. Most subsequent investigators have more or less fully confirmed their contentions, so that at the present time no one claims that a distinct continuous decidual membrane is formed in tubal pregnancy.

On the other hand, it must be distinctly stated that it is equally erroneous to believe that a decidual reaction is always lacking, as it is possible by careful study to distinguish clearly between fetal and decidual cells. In some cases apparently no trace of the latter can be observed, but in many specimens they can be found in discrete patches in the tips of some of the folds of the mucosa in the neighborhood of the ovum. Furthermore, careful study will occasionally enable one to distinguish decidual cells scattered between the fetal tissues at the placental site, but in none



FIG. 425.—SECTION SHOWING ATTACHMENT OF CHORION TO TUBE WALL. X 90.
Dec., Decidual cells; L. C., Langhans' cells; Syn., syncytium; V., villi.

of my specimens have I been able to observe structures analogous to the decidua vera or serotina of uterine pregnancy.

Observations by Webster, Voigt, Both, Couvelaire, Dobbert, Petersen, Lange, Kermauner, myself and others have proved the occurrence of decidual cells beyond all doubt. Accordingly, it would seem that the authors who deny their existence take too extreme a view.

That the tube is not incapable of a decidual reaction has likewise been demonstrated by finding characteristic decidual cells in the non-pregnant tube (Fig. 425). Such observations have been made by Webster, Mandl, Goebel, Janot, Krömer, myself and others, and are beyond all criticism, as in such cases there is no possi-

bility of confusing them with fetal cells. Moreover, Mandl and Lange have noted a similar reaction in the tubes in certain cases of uterine pregnancy, the latter having observed it in five out of fifty specimens.

From the considerations just adduced it is apparent that while a decidual reaction may occur in the tubes in tubal pregnancy, it is not universal, and never develops to the same extent as in the uterus. This fact is of interest not only from a scientific point of view, but also has a distinctly practical bearing, as it would seem to offer a satisfactory explanation for the invasion and destruction of the tube wall by the fetal elements. In uterine pregnancy such an invasion is noted only in the rare instances in which there is imperfect development of the decidua, and it would therefore appear that one of the main purposes of the latter is to protect the underlying maternal tissues against the invading and corrosive action of the fetal elements.

Decidua Reflexa.—It has already been indicated that from the time of Rokitansky one set of observers have held that a definite decidua reflexa is formed just as in uterine pregnancy, while others have contended just as strongly that it is usually absent. As advocates of the former view one may mention Hennig, Orthmann, Keller, Zedel, Winckel, Martin, Couvelaire, and Cornil; while the opposite view is maintained by Rokitansky, Leopold, Klein, Abel, Fraenkel, Füh, Kreisch, and Dobbert. Is it possible to reconcile such divergent and contradictory statements?

In view of the generally scanty development of decidual tissue in tubal pregnancy, it would appear, *à priori*, improbable that a typical decidua reflexa could be formed. On the other hand, all recent investigators who have studied the early stages of unruptured tubal pregnancy are agreed that the ovum is separated from the lumen of the tube by a definite membrane, made up of connective and muscular tissue, and bounded on one side by tubal epithelium and on the other by fetal elements (Fig. 424).

In the early days of pregnancy the nature of the membrane is perfectly clear, and as it does not contain decidual cells, it would be manifestly improper to describe it as a decidua reflexa. At the same time, it serves the same function as that structure, and accordingly may be designated as the pseudo-reflexa, or, better still, as the capsular membrane. As the pregnancy advances it becomes invaded by fetal cells, and to the casual observer may offer considerable similarity to a typical decidua reflexa. Gradually, however, under the corroding action of the fetal cells it undergoes degenerative changes, so that it eventually becomes converted into a layer of fibrinous tissue without definite structure. In the vast majority of cases it soon ruptures and allows the growing ovum to escape into the lumen of the tube as a tubal abortion. Occasionally, however, this does not occur, and in that event it comes in contact and eventually fuses with the mucosa of the opposite side of the tube, which then may become invaded by fetal elements.

It would accordingly appear that those authors who have described a typical decidua reflexa have confounded it with a capsular membrane infiltrated with fetal cells; while those who have denied its existence have based their conclusions upon

the study of specimens in which the capsular membrane had already ruptured, or had become so degenerated that it was impossible to distinguish its integral structure.

Placenta.—As has been stated, the early stages in the formation of the placenta are identical in both tubal and uterine pregnancy, and the main factor which influences its further development in the former is the absence or imperfect formation of a decidua serotina. As a consequence, the only obstacle to the invasion of the tube wall by the fetal elements is the natural resistance of the maternal tissues, and unfortunately this is rarely able to maintain a successful struggle. Accordingly the tube wall in contact with the ovum undergoes degenerative changes and becomes in great part converted into fibrin, which apparently offers such slight resistance that the chorionic villi and fetal cells invade the tube wall, open up its blood-vessels, and in a short time are to be found just beneath the peritoneum. It was this condition which caused Werth in 1887 to compare extrauterine pregnancy with a malignant growth.

In a small proportion of cases the fetal structures penetrate directly through the

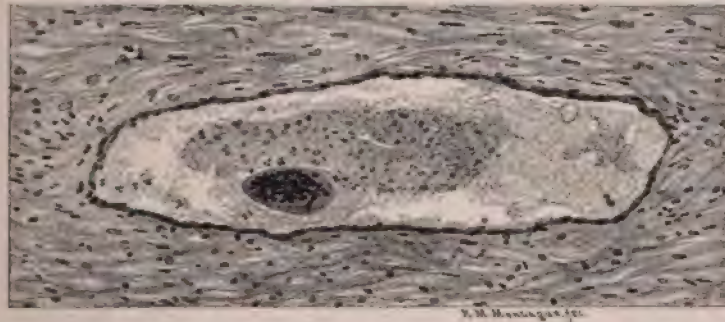


FIG. 426.—SYNCYTIAL MASS IN BLOOD-VESSEL OF TUBE, FAR REMOVED FROM PLACENTAL SITE.

peritoneal surface or through the capsular membrane, giving rise to intraperitoneal rupture or tubal abortion, as the case may be; although in the vast majority of cases early rupture is to be attributed to the sudden opening up of a large vessel, which gives rise to an increase of pressure, which the weakened tube walls are unable to withstand. Werth has quaintly expressed the condition in tubal pregnancy by stating that the ovum, in making its bed, digs its own grave.

The microscopic structure of the fetal portion of the placenta is identical in both tubal and uterine pregnancy, and does not call for extended description in this place. Likewise, just as in uterine pregnancy, but probably to a greater extent, particles become broken off from the fetal portion of the placenta—masses of Langhans' cells or syncytium, or even fragments of villi—and are carried by the veins to various portions of the body. This process, which was designated by Veit as "deportation," can be demonstrated by cutting serial sections of the tube at a point far removed from the site of pregnancy, and finding placental giant cells or even fragments of villi in the veins (Fig. 426).

ered by the decidual reflexa and a layer of fetal cells, as is the case in uterine pregnancy after the first few weeks.

This decidua is generally cast off from the uterus soon after the death of the fetus, either in toto or in small pieces (Fig. 427), and its discharge is usually considered to possess marked diagnostic significance; so much so that some writers in suspected cases have recommended curetting the uterus, and base their diagnosis upon the presence or absence of decidual tissue. My own experience has taught me that this is not necessarily so valuable a diagnostic sign as is generally believed, for in many instances it may be expelled without the knowledge of the patient and become replaced by a normal mucosa, so that examination of the material removed by the curet would show normal endometrium and absolutely no sign of decidual



FIG. 427.—UTERINE DECIDUA FROM A CASE OF EXTRAUTERINE PREGNANCY (Zweifel).

tissue. Pilliet has also had a similar experience, while Cazeaux states that in certain cases of hematosalpinx the endometrium presents the ordinary lesions of chronic endometritis, but no sign of decidual formation.

Terminations of Tubal Pregnancy.—

According to Tait, the universal fate of tubal pregnancy is rupture into the peritoneal cavity or between the folds of the broad ligament. More careful study, however, has shown that this statement is incorrect, and that the great majority of cases terminate at an early period by abortion after rupture through the capsular membrane, while in very rare instances the pregnancy may develop to term without rupture. Examples of the latter termination have been reported by Saxtorph, Spiegelberg, Chiari, Gutzwiller, Emanuel, Freund, and others, and I have a similar specimen. In the vast majority of cases, however, the pregnancy is interrupted at a much earlier period, by abortion or rupture.

Tubal Abortion (Intratubal Rupture).—It was not until 1887 that Werth directed attention to the occurrence of tubal abortion. Since then numerous investigators have substantiated his work, among whom may be mentioned Orthmann, Sutton, and Prochownick; so that at present it is regarded as the most frequent outcome of tubal pregnancy, instead of a pathologic curiosity.

The marked change which has taken place in this respect is clearly shown by comparing the statistics of Schrenk with those of more recent investigators. In 1892 he noted abortion only eight times in 610 cases of tubal pregnancy collected from the literature; while in 289 cases reported by Martin, Orthmann, Mandl and Schmidt, Fehling, and Glitsch, 78 per cent. ended by abortion and only 22 per cent. by rupture. According to Martin, "this process is the general rule, spontaneous

rupture occurring only in those cases in which closure of the abdominal end of the tube precludes the possibility of abortion; or where the ovum being inserted in a hernia of the mucosa, burrows directly through its wall."

All recent writers report a similar experience, although its frequency depends in great part upon the original site of implantation of the ovum. When in the ampulla, abortion is the general rule; while rupture into the peritoneal cavity is the usual termination of isthmic pregnancy—Couvelaire, Werth, Kermauner. This difference must be attributed to the fact that in the ampulla the tubal lumen is sufficiently patulous to permit a certain degree of expansion of the fetal sac, while in the isthmus the lumen is so small that this is impossible. Accordingly, growth can occur only toward the periphery, and therefore early rupture is the general rule.

Tubal abortion is practically always the result of rupture through the capsular membrane or pseudo-reflexa, and therefore does not differ materially from intra-peritoneal rupture, except in the fact that in the one case the hemorrhage and extrusion of the ovum occurs into the lumen of the tube, while in the other it takes place into the peritoneal cavity. Accordingly, the term abortion is not very happily chosen, and, as suggested by Berkeley and Bonney, the usual terminations of tubal pregnancy could well be designated as intra-tubal and extra-tubal rupture, respectively.

Intratubal rupture or abortion is brought about either by the direct perforation of the capsular membrane by fetal elements, or by the weakened and thinned out membrane yielding to a sudden increase in the interovular pressure. The latter may result from the sudden opening up of a large vessel by the invading fetal elements, by the clogging of large veins by chorionic villi (Veit, Pfannenstiel), or by the process described by Fellner as autothrombosis, in which the lumina of large venous channels have become occluded by decidual cells, which originated in their walls or invaded them from the outside.

The immediate consequence of the hemorrhage is a loosening of the connections between the tube wall and the ovum, and its complete or partial separation from its bed. If the separation is complete, the entire ovum is expelled into the lumen of the tube, and gradually forced by the hemorrhage toward its fimbriated extremity, through which it may ultimately be extruded into the peritoneal cavity (Fig. 428). Occasionally the ovum has been observed in the act of passing through the fimbriated extremity, and I have in my possession two specimens in which the fetus surrounded by its membranes is protruding through its dilated opening. On the other hand, if the separation is only partial, the ovum will remain *in situ*, while the hemorrhage continues.

Accordingly we are obliged to distinguish, just as in the uterus, between complete and incomplete abortions, the latter occurring far more frequently; Wormser, and Mandl and Schmidt, having observed the complete variety in only 2 out of 20, and 4 out of 50 cases of tubal abortion, respectively.

According to Werth and Veit, the complete extrusion of the ovum from the tube is brought about by muscular contractions, just as in uterine abortion; but Martin

and Orthmann believe that the tube wall plays only a passive part, the expulsion being effected by the *vis a tergo* exerted by the blood, which collects behind the ovum and gradually forces it through the tube. Prochownik, on the other hand, takes a middle ground, and supposes that while hemorrhage is the prime factor, it may be aided by the contractions of the tube on the uterine side of the sac.

The probability of complete tubal abortion is markedly increased the nearer



FIG. 428.—EARLY TUBAL ABORTION; OVUM IN LUMEN OF TUBE. X 6.

b. c., Blood-clot; v., villi.

the ovum is implanted to the fimbriated extremity, as under such circumstances it has a shorter distance to traverse. Cullingworth has pointed out that the tube occasionally retracts very rapidly after expelling the ovum, so that casual examination a few hours later would fail to reveal through which tube it passed.

Occasionally abortion and rupture may occur in the same tube, particularly when some obstacle is opposed to the onward passage of the ovum, such as a twist or partial closure of the fimbriated extremity; as under such circumstances

the blood which collects between the ovum and the uterus is subjected to such pressure that the weakened walls of the tube give way.

When the ovum is completely separated from the tube wall, and the hemorrhage following it is profuse, it is usually rapidly extruded; but when it is only partially separated, and the hemorrhage is moderate in amount, the ovum may increase markedly in size as the result of infiltration with blood, and become converted into a structure analogous to the bloody or fleshy moles observed in uterine abortions. Under such circumstances the hemorrhage continues as long as the mole remains within the tube, and slowly trickles from its fimbriated extremity, giving rise to a pelvic hemothecoele instead of free hemorrhage into the peritoneal cavity.

In a small number of cases the blood in the tube does not coagulate, but remains more or less fluid, giving rise to a hematosalpinx. At the present time it is generally believed that the vast majority of such cases originate from tubal pregnancy, as Cullingworth demonstrated such an origin in 14 out of the 17 cases which he observed.

After incomplete abortion small portions of placental tissue frequently remain attached to the tube wall. These become surrounded by larger or smaller quantities of fibrin, and a polypus results, just as frequently occurs after incomplete uterine abortion. Attention was first directed to this condition by Sutton, whose observations have been confirmed by Fränkel, Fehling, and other observers.

Rupture into the Peritoneal Cavity.

—Extratubal rupture does not occur anything like so frequently as Tait believed, as scarcely one-quarter of the cases of tubal pregnancy so terminate during the first twelve weeks.

When the pregnancy is situated in the ampulla, this termination occurs far less frequently than abortion; whereas in the isthmic variety it is the general rule. Moreover, it occurs at a much earlier period in the latter variety, and occasionally even before the patient is aware that she is pregnant. This tendency to early rupture was particularly emphasized by Bouilly, whose experience has been confirmed by Werth, Couvelaire, Kermauner, and most recent writers. Its explanation is to be found in the fact that the lumen of the proximal portion of the tube is too small to permit of any expansion on the part of the ovum, which consequently can find

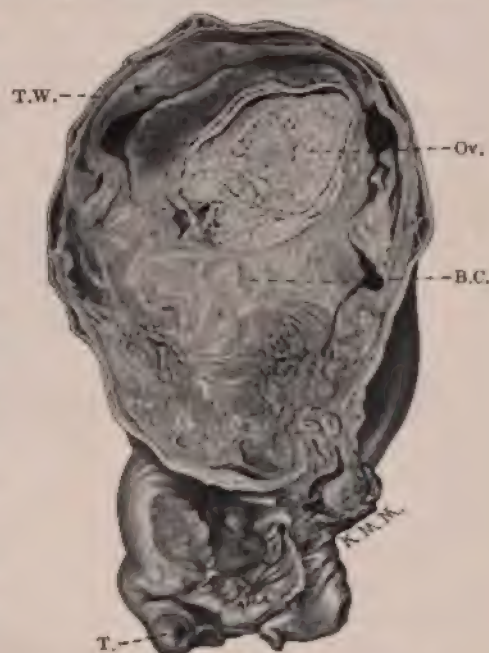


FIG. 429.—SECTION THROUGH TUBAL MOLE. X 1.
B. C., Blood-clot; Ov., ovum; T., uterine end of tube;
T. W., tube wall.

room for growth only by burrowing deeply into the muscularis, which soon yields to the invading villi.

Rupture is likewise the usual termination when the pregnancy is situated in the interstitial portion of the tube, but occurs at later period than in the other varieties of tubal pregnancy—rarely before, and not infrequently considerably later than, the fourth month. This difference must be attributed to the fact that this part of the tube is surrounded by uterine musculature, which reacts promptly to the stimulation of pregnancy and offers a greater resistance to the invading fetal structures than the tube wall.

The direct cause of rupture in any part of the tube may be violence, such as a vaginal examination, coitus, a fall, or even mere overexertion; though in the vast majority of cases it occurs spontaneously. In either event the underlying factor is the intramural embedding of the ovum, and the constant invasion and weakening of the wall by its ectodermal elements, and later by the growing chorionic villi.

The evidence at present available seems to indicate, except when the pregnancy is in the extreme proximal end of the tube, that direct perforation by fetal elements is less usual than the yielding of the weakened tube wall to a sudden increase of pressure in the intravillous spaces, following the sudden opening up of a large vessel, or the clogging of venous channels by chorionic villi. If rupture occurs in this way in an otherwise normal tube, it is apparent that it will be likely to occur at a much earlier period if the ovum be arrested in a diverticulum from the lumen of the tube, as under such circumstances it will have only a part of the tube wall to penetrate, instead of its entire thickness. Occasionally, secondary rupture may occur in a tube the seat of a primary abortion, although this is possible only when the fimbriated end is occluded.

Rupture usually occurs in the neighborhood of the placental site, and either into the peritoneal cavity or between the folds of the broad ligament, depending upon the original site of the ovum. The terminations of the two conditions differ so markedly that it will be necessary to consider them separately.

When it takes place into the peritoneal cavity, the entire ovum may be extruded from the tube, but, if the rent be small, profuse hemorrhage may occur without its escape. In either event the patient immediately shows signs of collapse, which may rapidly end in death. If the hemorrhage does not lead to a fatal termination, the effect of rupture varies according to the amount of damage sustained by the ovum. If expelled intact into the peritoneal cavity, its death is inevitable; and unless advanced beyond the third month it will be rapidly absorbed, as was shown by Leopold's experiments upon animals. It is still thought by many that under such circumstances the placenta may become attached to any portion of the peritoneal cavity, and there establish vascular connections, which will render further development possible. I do not believe that this can occur, as it is highly improbable that such connections could be established before the ovum had become irreparably damaged, not to speak of the negative evidence afforded by Leopold's experiments.

On the other hand, if only the fetus escapes at the time of rupture, the effect upon the pregnancy will vary according to the amount of damage sustained by the placenta. If much damaged, death of the fetus and termination of the pregnancy are inevitable; but if the greater portion of the placenta still retains its attachment to the tube, further development is possible, and the fetus may go on to full term, giving rise to a so-called secondary abdominal pregnancy. In such cases the tube may close down upon the placenta and form a sac in which it remains during the rest of the pregnancy; or a portion of the placenta may remain attached to the tube wall, while its growing periphery extends beyond it and establishes connection with the surrounding pelvic organs. Under such circumstances one may find the placenta attached partly to the tube and partly to the uterus, pelvic floor, rectum, or even the intestines.

I do not believe, however, that the placenta can become directly attached to organs far removed from the pelvic cavity, such as the stomach and diaphragm, for instance; and when such conditions are observed, I consider that one has to deal



FIG. 430.—RUPTURED AMPULLAR PREGNANCY.
Am., Amnion; O, ovary; P, placenta; T, uterine end of tube.

with a broad ligament pregnancy, in which the placenta is situated upon the upper portion of the fetal sac, which has become adherent to the organ in question.

Most authorities believe that further growth of the fetus is impossible, unless it is surrounded by the amnion; though several observers, notably Both, have reported exceptional cases in which a full-term fetus lay perfectly free in the peritoneal cavity, and all that was left of its membranes was found in the tubal sac.

In this connection may be mentioned a most interesting case reported by Leopold, in which the pregnant uterus had ruptured at about the fourth month, allowing the fetus and its membranes to escape into the peritoneal cavity through a rent in its posterior wall. At the operation the rupture was found to have healed completely except for a small opening through which the umbilical cord passed into the uterine cavity, where the placenta was normally attached. A similar case has also been reported by Henrotin.

Some years ago Webster reported a case of full-term extrauterine pregnancy which clearly showed the changes which may occasionally follow rupture. At oper-

ation the child lay in a thin-walled sac behind the omentum, while the placenta was still within the tube. After carefully studying frozen sections he was unable to demonstrate that the gestation sac consisted of two parts: a lower, composed of the tube in which the placenta was inserted, and an upper, in which the fetus lay and which was made up of amnion, newly formed connective tissue, and peritoneum. He designated the condition as tubo-peritoneal gestation, and supposed that it resulted from the early rupture of a tubal pregnancy, with the escape into the peritoneal cavity of the fetus surrounded by its amnion, and that the latter gradually became converted into the wall of the upper portion of the sac.

Rupture into Broad Ligament.—In a small proportion of cases rupture may occur at a portion of the tube uncovered by peritoneum, so that its contents and the subsequent hemorrhage are extruded between the folds of the broad ligament instead of into the peritoneal cavity.

Generally speaking, this is the most favorable variety of extratubal rupture, and usually terminates by the death of the ovum and the formation of a broad ligament hematoma, or exceptionally by the further development of the pregnancy between the folds of the broad ligament. When the latter occurs, it is apparent that the placenta could not have been completely detached from its tubal attachment at the time of rupture. In the exceptional instances in which it is situated opposite the point of rupture, it gradually becomes displaced upward as the pregnancy advances, and comes to lie above the fetus; while in the more usual cases it remains partly attached to the tube and gradually extends downward between the folds of the broad ligament, and forms vascular connections with the pelvic connective tissue.

When the pregnancy continues under such circumstances, the fetal sac lies entirely outside of the peritoneal cavity, and as it increases in size the peritoneum is dissected up from the pelvic walls, so that the condition is designated as extraperitoneal pregnancy. Occasionally the broad ligament sac may rupture at a later period, and the child be extruded into the peritoneal cavity, thus giving rise to a secondary abdominal pregnancy.

According to Webster, the first case of broad ligament pregnancy was observed by Bergeret. One of the earliest cases of this character was described by Loschge in 1818, but the first important contribution was made by Dezeimeris in 1836, who described the condition as "subperitoneo-pelvic pregnancy," but was unable to explain satisfactorily how the ovum made its way into the broad ligament.

The importance of this termination of tubal pregnancy was particularly emphasized by Tait, who believed that it was only under such circumstances that the fetus could go on to maturity. In view of what has been said, however, concerning unruptured full-term tubal pregnancy, it is evident that his statements were based upon imperfect information. Werth, in 1887, likewise directed attention to this condition, and collected 16 cases from the literature, though in his section upon extrauterine pregnancy in Winckel's "Handbuch der Geburtshülfe," he states that he has had no personal experience with it. Hart and Carter published a series of frozen sections from a case of this character, which had progressed to full term; and the former, in

a number of subsequent publications, has added materially to our knowledge concerning the condition. He showed that the term "sub-peritoneo-pelvic" is not applicable after the pregnancy has advanced beyond the first four or five months, when it should more properly be designated as "sub-peritoneo-abdominal."

I am confident that the frequency with which rupture occurs into the broad ligament has been overestimated, as I have observed it only once, and my experience is borne out by the statistics of several recent observers. Thus it was noted only 4 times in 276 cases of tubal pregnancy reported by Mandl and Schmidt, Küstner and Fehling; and Küstner suggests that a considerable number of cases which have been so interpreted were in reality due to the formation of intimate adhesions between the tubal sac and the posterior surface of the broad ligament.

Owing to the upward displacement of the peritoneum, and the consequent denudation of the pelvic organs, broad ligament pregnancies are brought into more intimate relations with the rectum and bladder than other varieties of extrauterine pregnancy, and accordingly are more prone to infection by intestinal bacteria; and after suppuration are liable to perforate either into the rectum or bladder, Winckel having shown that at least six out of the twelve cases of perforation into the bladder which he collected from the literature had resulted from this condition.

The terms "*tubo-uterine*" and "*tubo-abdominal*" pregnancy are sometimes applied to cases in which a primary tubal pregnancy develops partially into the uterine or peritoneal cavity, as the case may be. The first variety results from a pregnancy in the interstitial portion of the tube, and probably a certain number of cases of supposed extrauterine pregnancy which have terminated by spontaneous labor were of this character.

In tubo-abdominal pregnancy, on the other hand, the ovum is primarily inserted in the neighborhood of the fimbriated extremity, and gradually protrudes from it into the peritoneal cavity. Under such circumstances the protruding part of the fetal sac rapidly forms adhesions with surrounding organs, which at operation frequently offer serious complications. Neither of these conditions is very frequent, and does not deserve to be classified separately, as they differ from the usual forms of tubal pregnancy only in the fact that they have developed at unusual positions.

The term "*tubo-ovarian*" pregnancy is applied to cases in which the fetal sac is composed partly of tubal and partly of ovarian tissue. Such cases owe their origin to the development of an ovum in a tubo-ovarian cyst, or in a tube whose fimbriated end was adherent to the ovary at the time of fertilization, and are either primarily tubal or ovarian, and owe their peculiar character simply to accidental circumstances.

Vulliet is credited with being the first to describe such a condition, and since then not a few observers have reported similar cases, though they are not of frequent occurrence. Paltauf described a most interesting specimen, in which double tubo-ovarian cysts communicated with one another. Pregnancy occurred in the left cyst, and at autopsy a sound could be passed from the left cornu of the uterus,

through both ovarian cysts, and back into the uterine cavity through the right tube. Ashby has reported a typical case of tubo-ovarian pregnancy, which was carefully examined by Dr. Welch; and Leopold has described in detail six cases of his own.

It is likewise possible, as Mandl and Schmidt have pointed out, that not a few of the cases which have been described as tubo-ovarian are really nothing but tubal pregnancies with a solitary hematocele developed about the fimbriated end of the tube, and adherent to the ovary.

ABDOMINAL PREGNANCY.

Until comparatively recently the occurrence of abdominal pregnancy was universally admitted, and in Hecker's statistics it was reported twice as frequently as the tubal form. As, however, the specimens obtained at operation and autopsy were subjected to more careful study, it gradually became established that the majority of such cases were not primarily abdominal, but had resulted from ruptured tubal pregnancy. Finally doubt began to be cast upon the existence of the primary variety, and at the present time most authors are extremely skeptical as to its occurrence, though they admit its theoretic possibility.

As far as I can learn, Pfannenstiel is the only recent writer who does not share the general skepticism. On the other hand, Bland-Sutton positively denies its occurrence, and holds that all specimens which have been described as such have been imperfectly studied. Moreover, he contends that it is not observed in the lower animals, and states that the not infrequent finding of fetal sacs in the abdominal cavity is to be attributed to the rupture of a uterine horn with the extrusion of one or more embryos into the abdomen. This he considers is not a very rare accident, which in many instances does not lead to death.

Considerable light has been thrown upon the subject by the work of Zweifel, Martin, Voigt, Leopold, Werth, and others, who have conclusively demonstrated that the fertilized ovum may become implanted upon the fimbria ovarica—the tongue-like process extending from the fimbriated end of the tube to the ovary. These investigators have pointed out that only the most careful study prevented them from confounding the cases in question with primary abdominal pregnancies; but in all of them thorough microscopic examination showed the presence, at some point on the sac wall, of a structure covered by cylindric epithelium, which they identified as the unchanged portion of the ovarian fimbria.

In such cases it is apparent that as the pregnancy develops the surface to which the ovum was primarily attached will be far too small to accommodate the placenta, and accordingly its margins soon extend beyond the primary site of implantation, and becoming attached to surrounding organs, give the impression that it had been implanted primarily upon the peritoneum.

Zweifel, when he first examined his specimen, considered that it was undoubtedly a primary abdominal pregnancy, and only recognized its true nature after most careful study. Walker, in 1887, described a case which has long figured as an un-

assailable example of this condition; but, as Zweifel has pointed out, his accurate microscopic description leaves very little doubt that it was likewise a pregnancy upon a fimbria ovarica.

I, therefore, do not believe that a single case has thus far been reported which affords indisputable proof of the primary occurrence of abdominal pregnancy; but at the same time one must admit such a possibility, especially in view of the fact that Walker, Zweifel, and Voigt have demonstrated the development of decidua cells in the subperitoneal tissue, and also that Schmorl has shown that decidual nodules appear upon the pelvic peritoneum in the course of normal uterine pregnancy.

FATE OF THE FETUS IN EXTRAUTERINE PREGNANCY.

I have already pointed out that absorption is the universal fate of small embryos which are extruded into the peritoneal cavity, unless the placenta remains firmly attached to the tube. This is clearly demonstrated in some cases by our inability to find a trace of the fetus in the blood which fills the abdominal cavity after rupture. It is likewise certain that small embryos are frequently absorbed while still in the tube; as one often finds upon opening early gestation sacs that the fetus is represented by a formless mass of tissue attached to the umbilical cord, while in other cases a short portion of the cord hanging free in the amniotic cavity is the only indication of its previous existence.

When the fetus, however, has attained a certain size, it cannot be absorbed in this manner, and one accordingly has to consider the changes which it may undergo, whether it remains in the gestation sac or lies free in the abdominal cavity. Generally speaking, these may be: mummification, skeletization, lithopedion formation, suppuration, and adipocere formation.

In *mummification* the fluid portions of the fetus are gradually absorbed and its internal organs converted into a soft, pulpy mass which is gradually absorbed, so that eventually nothing is left except the skeleton, whose bones are held together by a dry and shriveled skin.

If infection does not occur, the mummified fetus or the membranes surrounding it, or both, become covered by a coating of calcareous material, and a structure results to which the name "*lithopedion*" is generally applied.

One of the earliest recorded cases of this character is the so-called lithopedion of Sens (*Lithopædion Senonensis*), which was removed from a woman in the town of Sens in 1601, and has become immortal among English-speaking people by its misuse in "*Tristram Shandy*." Likewise, one of the most interesting specimens of lithopedion on record was obtained at Leinzell in 1720, at the autopsy upon a seventy-four-year-old woman, who had carried it within her for forty-eight years, during which time she had several children. This has been described by several writers, but particularly by Kieser in 1854, who collected most of the cases which had been reported up to that time. The condition was also exhaustively considered

by Albers in 1861, who collected ten cases from the literature, eight of which had been retained by their mothers for twenty-five years or more.

The most valuable monograph upon the subject we owe to Küchenmeister, who after carefully reviewing the literature and studying several cases of his own, divided lithopedia into three classes: (1) In which the calcification is limited to the fetal membranes (litho-kelyphos); (2) both fetus and membranes partially calcified (litho-kelyphopedion); and (3) in which the calcification is limited entirely to the fetus (lithopedion).

Lithopedion formation is comparatively rare, and is generally regarded as the most favorable outcome in advanced cases of extrauterine pregnancy, as the calcified fetus may be carried for years as a harmless foreign body, and do no harm except at labor, when it may give rise to partial or complete obstruction of the pelvis. I have been able to collect from the literature a number of cases in which a lithopedion had been carried for fifty years or more, and over thirty cases in which a period of twenty-five or thirty years elapsed between the pregnancy and the removal of the specimen at autopsy or operation.

In a considerable number of cases in which the dead product of conception remains within the mother, suppuration of the sac occurs and gradually spreads to the fetus and eventually leads to the liquefaction of all its parts except the skeleton. As the process advances, adhesions are formed with the various organs, and an abscess forms, which eventually perforates at the point of least resistance; and if the patient does not succumb to septic intoxication, portions of the skeleton may be extruded through the abdominal walls, or into the intestines, bladder, or vagina. As has already been indicated, this termination occurs with especial frequency in broad ligament pregnancy, on account of the proximity to the rectum and the liability of infection by intestinal bacteria.

In exceptional instances the tissues of the fetus may become converted into a yellowish, greasy mass, to which the term "adipocere" is applied. The fatty material is supposed to be an ammoniacal soap, but no one has as yet advanced a satisfactory explanation for its formation.

DISEASES OF THE OVUM IN EXTRAUTERINE PREGNANCY.

The formation of typical blood or fleshy moles and placental polypi after tubal abortion has already been mentioned, and it must be admitted in a general way that the ectopic ovum is subject to the same diseases and abnormalities as in normal pregnancy. In this connection it is interesting to note that Schauta, Wertheim, and Micholitsch have described tubal ova, which had become converted into hematoma moles—the tuberos subchorial hematoma of the decidua of Breus. Moreover, it would appear likely that a similar condition may develop in ovarian pregnancies, which terminate in the death of the fetus without rupture.

The occurrence of hydatidiform moles has been reported by Otto, Recklinghausen, Wenzel, Matwejew and Sykow, and others, and it would appear that the

condition does not differ materially from that observed in the uterus. Chorio-epithelioma likewise occurs after tubal pregnancy, and ten additional cases have been reported since Ahlfeld and Marchand first described it. Those interested will find the complete literature upon the subject up to 1905 in the monograph of Risel.

When the comparative infrequency of extrauterine pregnancy is taken into consideration, it would appear to be followed quite as often by chorio-epithelioma as uterine gestation. Moreover, when the fact is recalled that at least one-half of such cases have been preceded by hydatidiform mole formation, it would appear that the latter abnormality must occur more frequently than is indicated by the statements in the literature.

Abnormalities in the amount of liquor amnii are frequently observed, and most cases of advanced tubal pregnancy are characterized by a diminution in its quantity which no doubt plays an important part in the production of fetal deformities. On the other hand, hydramnios may occasionally be observed. Parry mentioned the cases described by Vassal, and Depaul, and since then similar observations have been made by Teuffel, Webster, Lindfors, and others. In the last two cases the amnion contained, respectively, 25 and 12 liters of fluid.

Various unimportant abnormalities of the placenta have also been described in advanced cases, although no one has as yet reported syphilitic lesions in the fetus or placenta, but in view of their marked frequency in uterine pregnancy, it is more than likely that they will soon be described.

Cases reported by Spiegelberg and Holst occupy almost unique positions in the history of extrauterine pregnancy, as the patients had eclampsia during false labor.

SYMPTOMS.

Unfortunately the symptoms of uninterrupted extrauterine pregnancy are not characteristic, and therefore the patient and her physician are usually entirely unaware of its existence until rupture or tubal abortion occurs. In many instances the patient considers herself pregnant, and presents the usual subjective symptoms of that condition. She may complain of slight pain in one or other ovarian region, to which she pays but little attention. Less frequently she has no idea that she is pregnant, and rupture may occur and end fatally before a menstrual period has been missed. Thus, I know of a multiparous woman, with a perfectly normal menstrual history, who died from hemorrhage following rupture fifteen days after her last period; and similar cases have been reported by Orthmann, Duncan, Spencer, Gottschalk, and others.

Suppression of the menses does not occur so regularly in extrauterine as in normal pregnancy, and the experience of recent writers tends to show that it is of comparatively little diagnostic value; since menstruation persisted in 43 per cent. of 131 cases observed by Martin and Orthmann, Bouilly and Wormser. Such statements, however, do not necessarily indicate that the patient is menstruating nor-

mally; as the hemorrhage is frequently due to an endometritis. Moreover, if the fetus dies at an early period and rupture or abortion does not occur, there is usually more or less uterine hemorrhage, which may be mistaken for the menstrual flow or an early abortion, the possibility of the latter being still further confirmed by the discharge of the uterine decidua, which is usually cast off in shreds or small pieces, and only rarely as a characteristic triangular cast.

This being the case, it frequently happens that the first sign of the existence of the abnormal pregnancy is afforded by sudden lancinating pain in one or other ovarian region, which is soon followed by marked faintness on the part of the patient, who becomes extremely pallid, rapidly passes into a condition of collapse, and may present a subnormal temperature. Such a condition indicates rupture of the tube with free hemorrhage into the peritoneal cavity. Under such circumstances the collapse and other symptoms of internal hemorrhage rapidly become more pronounced, and the patient may die in a few hours unless saved by operative aid. Occasionally, however, the primary hemorrhage is not sufficiently severe to cause death, and the patient may gradually recover from the first attack, only to have it recur at a later period.

On the other hand, if the symptoms of collapse are not so pronounced the probabilities are that one has to deal with a tubal abortion, which is accompanied by a trickling of blood into the abdominal cavity through the Fallopian tube. In such cases the general condition of the patient is not as a rule alarming, and she gradually recovers from the acute attack, while vaginal examination a few days later shows that the pelvic cavity is filled out to a greater or less extent by a fluctuating tumor—pelvic hematocele.

In all the earlier text-books upon gynecology, pelvic hematocele was considered as a distinct disease, and its connection with extrauterine pregnancy was not fully established until Veit, in 1877 and 1884, clearly demonstrated that most cases had been preceded by symptoms referable to tubal pregnancy. According to Pilliet, Aran in 1855 was the first to direct attention to this fact, but his work did not attract the attention it deserved, and practically passed unnoticed. Tait held that this was a universal rule, and that the mere existence of a hematocele afforded positive evidence of extrauterine pregnancy.

It appears, however, that this is too extreme a view, and most modern writers, while admitting its general correctness, believe that hematocele formation may occasionally result in other ways. Thus, Thorn demonstrated such a connection in 57 per cent. of his cases, and Cullingworth noted it in twenty-three out of his twenty-four cases of hematocele.

As has already been indicated, hematocele formation usually follows tubal abortion; but it may likewise occur after rupture, provided the hemorrhage is not too profuse. It is customary to distinguish between diffuse and solitary hematocele, according as the collection of blood occupies a considerable part of the pelvic cavity, or is restricted to the neighborhood of the fimbriated extremity of the tube.

The diffuse variety usually occurs when adhesions are already present between

pelvic organs. These facilitate the coagulation of the blood and aid in the formation of an organized membrane over it, by which it is shut off from the abdominal cavity. Owing to its formation about existing adhesions, the removal of such a hematocele is not always easy, as it cannot be shelled out of the pelvic cavity until the original adhesions are broken through.

According to Sanger, on the other hand, the existence of adhesions is not essential to the formation of the solitary hematocele. He held that such a structure might be formed when the blood trickled slowly enough from the fimbriated end of the tube to permit the coagulation of its outer portion, thereby giving rise to a capsule which became organized and gradually enlarged as the blood was poured out into its interior. As the solitary hematocele enlarges it comes in contact with and often adheres to the surrounding structures, but it can usually be removed at operation without great difficulty, being peeled out from the pelvic cavity just as an ordinary tubal or ovarian tumor.

Hematocele formation, whether diffuse or solitary, is a very favorable termination of tubal pregnancy; for, if let alone, it is gradually absorbed and complete recovery of the patient results. Thorn, for example, has reported 157 cases with a mortality of 0.6 per cent. and Fehling 91 cases without a single death. It should not be understood, however, that it is universally favorable, for occasionally the hemorrhage may persist and the hematocele become larger and larger, until at last its capsule ruptures and pours its contents out into the peritoneal cavity; while in not a few cases intestinal bacteria may make their way into it and give rise to suppuration.

If the patient does not succumb to the collapse following rupture, and if the placenta has not been separated to too great an extent, a secondary abdominal pregnancy may result and the fetus may continue its existence. Under such circumstances the usual symptoms of pregnancy persist, except that the patient suffers more pain and feels the fetal movements more acutely than in uterine pregnancy. No doubt part of the pain is due to the distention and possibly to contractions of the fetal sac, but the greater part of it must be attributed to the stretching of adhesions which have formed between it and the various abdominal organs.

In the exceptional cases, in which the primary rupture occurred into the broad ligament, secondary rupture may occur at a later period, and lead to death from hemorrhage or to a secondary abdominal pregnancy. In the latter case the fetus will lie in the peritoneal cavity, while the placenta remains within the folds of the broad ligament.

If the secondary abdominal pregnancy or the very rare cases of unruptured tubal or ovarian pregnancy continue, false labor sets in at term, and is accompanied by distinct contractions, similar to those in the early stages of normal labor, but which, of course, can have no effect upon the birth of the extrauterine child. The pains are due to uterine contractions, as in the majority of cases the fetal sac, even if unruptured, contains so few muscular fibers that its contraction is practically impossible. Exceptionally, however, as in a case reported by Pinard, it may be richer than usual in muscular tissue and give rise to definite contractions.

False labor may last for a few hours or a number of days, and is soon followed by the death of the child, although in a small number of cases fetal movements have been felt for a considerable time afterward. After the death of the fetus the placental circulation gradually becomes abolished, the intervillous spaces become filled with fibrin, and the chorionic villi undergo degenerative changes. At the same time the amniotic fluid is absorbed and the fetal sac becomes retracted over the more or less mummified fetus, so that it occupies a much smaller space than formerly. The abdomen, in consequence, becomes smaller and its change in size is soon noticed by the patient.

After its initial shrinking the tumor may remain stationary for a number of years, the child within it becoming mummified or converted into a lithopedion; while in other cases inflammatory symptoms make their appearance, and an abscess is formed, which may rupture externally and be followed by a gradual discharge of the fetus, or lead to the death of the patient from exhaustion or peritonitis.

Combined and Multiple Pregnancy.—Parry stated in his monograph that 22 out of the 500 cases of tubal pregnancy which he collected were also associated with intrauterine pregnancy, and designated the condition as combined pregnancy. Since then a number of authors have written upon the subject, and many additional cases have been reported. B. B. Browne read a paper upon the subject in 1882, before the American Gynecological Society, and, while apparently ignorant of the work of Parry, collected nearly all the cases to which he referred and added four additional ones.

Since 1896 the condition has been frequently observed and a number of monographs have been written upon the subject by Pantellani, Gutzwiller, Moseley, Strauss, Zincke, Christer-Nilsson, Bichat, Simpson, and Weibel. Some idea of the increase may be obtained from the fact that Strauss in 1898 was able to collect from the literature but 32 cases, while Weibel in 1905 had increased the number to 119.

It should also be noted that in the more recent collections of cases only those have been included in which both the intrauterine and extrauterine pregnancies were of the same age, and no account is taken of the cases in which uterine conception occurred while the patient was carrying within her the remains of an old extrauterine pregnancy.

In rarer instances twin tubal pregnancy has been observed, the two embryos being sometimes in the same tube, while in other cases one was found in each tube. Several such cases are mentioned in the monographs of Hennig, Parry, and Webster, while the more recent cases were collected in 1904 by Jayle and Naudrot.

Sänger and Krusen have reported cases of triplet tubal pregnancy, all of the embryos being of the same age.

Repeated Tubal Pregnancy.—Parry collected eight cases of this character from the literature, and stated that Primrose had made the first observation in 1594. These early cases, however, are of very questionable value, as the case of Haydon in 1863 was the only one to be confirmed by autopsy.

With the modern development of abdominal surgery, however, the abnormal-

It has been observed quite frequently. Abel in 1893 collected the first series of cases, while the articles of Weil in 1901 and Heikel in 1903 have shown that it is not an unusual occurrence. In several instances only a few months elapsed between the two pregnancies, while in others they were separated by a period of years. I operated twice upon the same patient at an interval of eighteen months, and Charles P. Noble after an interval of only six months.

One of the most interesting cases of this character was reported by H. C. Coe, who kindly sent me the specimen for examination. In this instance an interval of eleven years had elapsed between the two pregnancies, and at the operation a freshly ruptured four months' pregnancy was found at the lateral end and a lithopedion in the isthmic portion of the same tube. The case was also of interest, as it conclusively demonstrated the occurrence of external migration of the ovum, a fresh corpus luteum having been found in the ovary opposite the pregnant tube. As the lithopedion completely occluded the median portion of the pregnant tube, it is apparent that the spermatozoa must have traversed the opposite tube and fertilized the ovum soon after it left the ovary, after which it was carried to the other tube, which it descended until arrested by the lithopedion.

The Effect upon Subsequent Child-bearing.—In a considerable number of cases the presence of an old extrauterine pregnancy exerts no influence upon the course of subsequent labors. This was first demonstrated by the patient from whom the Leinzell lithopedion was obtained, as she had two spontaneous labors while carrying it. Similar cases are not rare, and it is interesting to note that two of the earliest cases of extrauterine pregnancy observed in this country were of the same character. Thus, the patient reported by Osgood in 1745 had six subsequent labors; while in John Bard's case in 1759 a single spontaneous labor followed.

Occasionally, however, the remains of an old extrauterine pregnancy give rise to serious dystocia, and have necessitated the performance of major obstetric operations in subsequent labors. Thus, the pelvic canal was so obstructed in the cases of Hugenberg, Schauta, and Sänger that Cesarean section was required, which would also have been necessary in Ott's case had a miscarriage not occurred at the sixth month. Likewise premature labor was induced by Hennigsen, Dibot, and Brossi, while Stein the younger and Cheston performed craniotomy under the same circumstances.

That such difficulties, however, are not usual, is shown by the careful study of Funck-Brentano, who has collected 126 cases of spontaneous labor following extrauterine pregnancy—92 occurring while the patients were still carrying the remains of the old condition, and 34 some time after its removal by operation.

DIAGNOSIS.

Unfortunately early unruptured extrauterine pregnancy is rarely diagnosticated, as the symptoms to which it gives rise are usually too slight to cause the patient to consult a physician, and the majority of English and American writers follow the

example of Tait and believe that such a diagnosis cannot be made. As far as I can learn, Veit in 1883 was the first to confirm by operation a positive diagnosis of this character, while Janvrin in 1888 was apparently the first American to do likewise.

Such a diagnosis is based upon finding a unilateral tubal tumor in a patient presenting the usual subjective and objective symptoms of early pregnancy, especially if she has been sterile for a number of years, or if a long interval has elapsed since her last pregnancy. The uterus is somewhat enlarged and softened and the tubal tumor is soft and doughy, and roughly corresponds in size to the supposed duration of the pregnancy; but the experience of most operators, after making such a diagnosis, is to find at operation that the tumor is of some other nature. Occasionally a sacculated condition of the pregnant uterus may apparently offer the physical signs of an unruptured extrauterine pregnancy, and I operated upon a case of this kind only to find the ovum inside of the uterus.

As Taylor has pointed out, the unruptured pregnant tube frequently prolapses into Douglas' cul-de-sac, and may be mistaken for a retroflexed pregnant uterus, and not a few cases have been reported in which rupture followed an attempt to replace it.

Even after the death of the fetus a positive diagnosis is not readily made unless rupture of the fetal sac has occurred, and the majority of such cases are mistaken for uterine abortion or tubal tumors of inflammatory origin. The possibility of the first mistake was first emphasized by Wyder in 1886, who stated that one should never attempt to empty the uterus in cases of suspected incomplete abortion, without having previously carefully palpated the tubes and ovaries; and if a tumor is found on one or other side of the uterus, the possibility of the existence of a tubal pregnancy is very great. The possibility of error is due to the fact that in tubal pregnancy fetal death is usually associated with some uterine hemorrhage and the discharge of decidual tissue. Occasionally, the latter is discharged intact as a triangular cast of the uterine cavity, but more frequently it comes away in shreds, which are mistaken by the patient for portions of the ovum. Moreover, the fact that the patient usually destroys whatever is discharged from the uterus, increases the possibility of error, as the physician is obliged to rely upon her statements as to its appearance.

It is generally taught that the discharge of an intact decidual cast is a characteristic sign of extrauterine pregnancy, and no doubt this holds good in the majority of cases; but occasionally a similar structure may be discharged without the existence of pregnancy of any kind. This was demonstrated by the experience of Griffiths and Dakin, who diagnosticated extrauterine pregnancy from the discharge of such a cast, and at operation the former found the pelvic organs perfectly intact and the latter a small ovarian cyst. Eden had a similar experience, except that he did not operate, as a very careful examination of the patient by Herman absolutely precluded the existence of such a condition.

Ott, Ayres, and others believe that the discharge of a decidual membrane or the presence of decidual tissue in the empty uterus, when a tumor mass can be detected

on one side of it, is a positive diagnostic sign of extrauterine pregnancy, and, in doubtful cases, recommend curetting the uterus for diagnostic purposes. My own experience has taught me that, while the presence of decidua under such circumstances usually affords strong presumptive evidence, its absence is not equally convincing from a negative point of view. For occasionally the decidua may have been cast off at an early period and become replaced by normal endometrium, so that the examination of the material removed will be negative. Pilliet and Cazeaux report a similar experience.

Taking all these factors into consideration, a probable diagnosis can usually be made after fetal death, but before the occurrence of rupture or abortion, and is based upon the history of the patient and the findings upon vaginal examination. Its possibility should always be considered when a patient, after amenorrhea lasting a few weeks or months, complains of uterine hemorrhage and the discharge of shreds of tissue, in which no trace of a fetus can be found, especially if she presents a history of sterility or previous pelvic inflammatory trouble. Furthermore, the diagnosis is rendered very probable when vaginal examination shows a somewhat enlarged uterus and a tubal tumor, which corresponds in size to the supposed duration of the pregnancy. In not a few cases, on the other hand, operation will show that the supposed pregnancy is nothing but a pelvic inflammatory mass or a small ovarian tumor.

If a patient with the above history, or even one who does not suspect the existence of pregnancy, suddenly becomes faint, pallid, or unconscious, and then passes into a condition of collapse, the diagnosis of ruptured tubal pregnancy or of tubal abortion with profuse intraperitoneal hemorrhage becomes practically certain, and at operation a large quantity of blood will usually be found in the peritoneal cavity. Unfortunately vaginal examination in these cases reveals but little, as the patient is usually so extremely sensitive that an accurate examination is impossible.

If the symptoms of collapse are very marked and the patient is pallid and presents a subnormal temperature, the diagnosis of rupture is positive. On the contrary, in tubal abortion the collapse may be quite marked and out of all proportion to the amount of blood lost, but is not associated with pallor or subnormal temperature, so that, as Bouilly has pointed out, the presence or absence of the last two symptoms may be of considerable diagnostic value. Moreover, if the patient rapidly recovers from the collapse, the probabilities are in favor of tubal abortion, while the subsequent formation of a hematocele practically settles the question.

As has already been pointed out, rupture may occur at a very early period, and even before the patient believes herself pregnant. Therefore, in a woman during the childbearing period, one should regard sudden collapse associated with the symptoms of intra-abdominal hemorrhage as *prima facie* evidence of ruptured tubal pregnancy, even though a menstrual period has not been missed. By so doing, and operating promptly in suitable cases, a number of lives may be saved which otherwise would inevitably be lost.

The majority of cases, however, come into the hands of the operator after the

patient has recovered from the primary shock, and under such circumstances vaginal examination will show a mass on one side of the uterus which may or may not be the result of extrauterine pregnancy. Such cases are usually mistaken for pelvic inflammatory troubles or vice versa. When a mass containing fluid can be felt posterior or lateral to the uterus, exploratory vaginal puncture followed by the escape of bloody fluid establishes the existence of a hematocele, though I do not recommend such a procedure for diagnostic purposes.

If the child has survived the rupture, a correct diagnosis is rarely made until full term is reached, unless one's attention is particularly directed to its possibility by the previous history of the case. Under such circumstances the true condition of affairs is readily recognized, as the uterus will be found enlarged to about the size of a three months' pregnancy, while the child lies in a sac outside of it or even free in the abdominal cavity and can be palpated much more readily than usual. When the diagnosis is doubtful the introduction of a sound into the uterus is permissible; on the other hand, if the previous history is not known, and the patient is not carefully examined, she will usually be considered as normally pregnant until the occurrence of false labor teaches otherwise.

When the pregnancy continues after rupture into the broad ligament, the diagnosis may be confirmed by finding a tumor intimately connected with the uterus, and depressing the vaginal vault laterally or even posteriorly to it, instead of lying higher up in the abdominal cavity.

After extrauterine pregnancy has reached full term, the diagnosis is usually easy, and is based upon a history of false labor, followed by a gradual decrease in the size of the abdomen. Physical examination in such cases will show the uterus practically normal in size and pressed against the symphysis or down into the pelvis by a large tumor more or less closely connected with it, in which the outlines of the child can occasionally be distinguished. In exceptional instances, where the child is surrounded by a greater quantity of amniotic fluid than usual, the fetal sac may be mistaken for an ovarian tumor, as in the case reported by Teuffel.

To recapitulate, a positive diagnosis of unruptured tubal pregnancy can occasionally be made; but the vast majority of cases escape detection until rupture or abortion has occurred, when the diagnosis is readily established. In advanced cases careful examination will usually lead to correct diagnosis, while after false labor the history is so characteristic that mistakes should rarely be made.

The diagnosis of combined intrauterine and extrauterine pregnancy is rarely made until the abortion of the former or the rupture of the latter leads to a minute examination of the patient, and even then one of the pregnancies may occasionally be overlooked until operation or autopsy. The condition has never been diagnosticated in the later months, though in several instances the existence of twins has been detected, but the possibility of combined pregnancy was not considered until after the delivery of the uterine child, when an attempt to find a cause for the delayed birth of the other revealed the fact that it lay outside of the uterine cavity.

TREATMENT.

When unruptured extrauterine pregnancy is diagnosticated, its prompt removal by laparotomy is urgently indicated, as rupture may occur at any time and cause the death of the patient before art can come to her aid.

The importance of immediate operation cannot be too strongly emphasized, and all methods which aim to destroy the fetus and thus terminate the pregnancy without operation are, to my mind at least, absolutely unjustifiable. This applies not only to the use of electricity, but also to the injection of poisonous substances into the gestation sac. Even admitting the possibility of destroying the fetus by such means, the danger to the mother is not at an end, as we know that rupture may take place after its death; and even should this fail to occur, the retention of the product of conception in the tube renders it a useless organ and may expose the patient to considerable danger. Unfortunately, however, it is only rarely that one has to consider the treatment of such cases, as the diagnosis is usually not made until rupture or tubal abortion has occurred.

Tait, in 1883, was the first to perform laparotomy for ruptured tubal pregnancy, and since he demonstrated the ease with which the operation could be performed and the surprisingly good results which followed it, all gynecologists have followed his example, and most of us can recall many cases which have been saved in this way, which otherwise would have been hopelessly lost.

The performance of laparotomy for the purpose of checking hemorrhage from a ruptured tubal pregnancy was first suggested by W. W. Harbert, in 1849. Stephen Rogers, in a monograph in 1867, stated, "the peritoneal cavity must be opened, the bleeding vessels must be ligated"; and further on: "What would we say of a surgeon who would sit quietly by and see the life-blood flow from a divided vein or artery, and make no effort to arrest it? He who recognizes the presence of blood in the peritoneal cavity, with a coincident history, such as has been detailed above, has no better excuse for inaction." The propriety of operation was also most eloquently urged by Parry in 1876, but Tait was the first who had the courage to adopt their suggestions.

The beneficent effects of the operation were soon recognized, and were clearly demonstrated by the statistics of Schauta, who, after a careful study of the literature, compared the results following operation in 123 cases with those observed in 121 cases treated palliatively, and reported a mortality of 5.7 and 86.89 per cent. respectively.

At present every one agrees as to the propriety of operation in suitable cases, and merely has to determine when it is indicated and how it is best performed.

In every case in which the collapse is marked and the patient presents a pallid appearance and subnormal temperature, immediate laparotomy is indicated, unless her condition is so desperate that death appears imminent, and even under such circumstances recovery sometimes follows prompt operation.

The abdomen should be opened rapidly, under cocain anesthesia if necessary,

the hand passed down alongside the uterus and the tubal mass seized and clamped on both sides by long forceps, after which the mass may be removed and the clamps replaced by ligatures at comparative leisure. In many cases the abdomen is filled with blood, which spurts from the wound as soon as the peritoneum is incised, and completely obscures the field of operation. Under such circumstances the clamps should be applied by the sense of touch, without attempting to clean out the pelvic cavity, after which the blood-clots may be removed and the field of operation cleaned up so as to enable one to complete the operation under the guidance of the eye. After removing the fetal sac and ligating the vessels, it is not necessary to remove all the blood from the peritoneal cavity unless the patient's condition is fairly satisfactory, as one may lose more by attempting to do so than by allowing a small amount to remain behind.

Not infrequently the tube and ovary on the other side may be the seat of chronic inflammatory lesions, and their removal should depend upon the condition of the patient, it being far better to allow them to remain than to run any risk with a very ill woman.

Sippel's suggestion of placing the patient in the Trendelenburg position and infusing with salt solution, either subcutaneously or intravenously, while the necessary preparations for the operation are being made, may be followed with advantage if the conditions are desperate; while in other cases an intravenous injection of salt solution may be commenced almost simultaneously with the administration of the anesthetic.

When laparotomy has been undertaken in cases of tubal abortion, Prochownik, Martin, and others have advocated attempting to save the pregnant tube if possible, by opening it, removing the products of conception, and then repairing it by suture. Such a procedure may occasionally be admissible, but it has not yet been demonstrated that a tube so treated regains its normal function.

Of late years Martin, Dührssen, and many others have advocated attacking extrauterine pregnancy from the vagina. I, however, do not believe that it is the most suitable method of operating in freshly ruptured cases, although it may give equally good results under other circumstances, when its employment should be governed by the predilections of the operator. The advantages which are claimed for it are avoidance of an abdominal incision and the subsequent danger of hernia, the lessening of shock to the patient, and the increased rapidity of convalescence. But against these must be placed the added difficulty of the operation, the limited view of the field of operation, and the possibility of not being able to complete it by the vaginal route, and of being obliged to resort to laparotomy to check hemorrhage. Those who are particularly interested in the subject I would refer to the articles of Henrotin and Segond, who have considered the relative merits of the two operations.

Turning from the consideration of the treatment of acute hemorrhage following ruptured extrauterine pregnancy to the cases of hematocele formation, we find it is a subject upon which most recent writers express themselves very conservatively;

as it has been shown that the great majority of such cases undergo spontaneous cure if let alone, and that operation is necessary only when suppuration occurs or when the hemorrhage continues. Thus, Thorn operated upon only 6 out of 157 cases of hematocele, while the rest were treated by rest in bed under careful supervision, with a mortality of only 0.6 per cent.; and Fehling has recently reported 91 similar cases without a death. At the same time these writers state that such treatment requires prolonged rest in bed and careful watching, the average stay of the patients in the hospital having been 54.6 days, and they therefore admit that it is frequently not applicable to women of the poorer classes, upon whom laparotomy must often be performed.

Rapid increase in the size of the hematocele indicates that the hemorrhage is continuing, and under such circumstances laparotomy is urgently demanded. Likewise, if it does not increase in size, but gives rise to pressure symptoms, or begins to show signs of infection, prompt operation is indicated. Under such circumstances many operators hold that vaginal incision, followed by the removal of the blood-clot, with subsequent packing, gives most excellent results. Kelly, Segond, and others have demonstrated its advantages, but at the same time admit that conditions may occasionally arise which will render it impossible to complete the operation by the vagina, and require immediate laparotomy to check hemorrhage. Accordingly, when the vaginal route is chosen, the patient's abdomen should also be prepared in advance for laparotomy, so that no time will be lost should it become necessary to resort to it.

From my own experience I am inclined to agree with Fehling, who believes that laparotomy is the operation of choice in the cases of hematocele in which interference is required, as it at once puts one in a position to do whatever may be necessary, without being compelled to resort to some other operation. On the other hand, it would appear that the vaginal route is well adapted for the evacuation of certain broad ligament hematomata.

What has thus far been said applies only to the treatment of the condition in the first four months of pregnancy. In the later months the methods of operating differ considerably, according as the fetus is living or dead. Very exceptionally the live fetus may be inclosed in a tubal or ovarian sac, and somewhat more frequently a broad ligament pregnancy may have continued to develop subperitoneally, but usually one has to deal with a secondary abdominal pregnancy, the child and its membranes being in the peritoneal cavity, and the placenta either within the tube or broadly implanted upon it and the floor of the pelvis. Whatever the anatomic conditions may be, advanced extrauterine pregnancy with a living child is always attended with considerable danger to the mother, as the possibility of sudden hemorrhage is always present; and I therefore believe that prompt laparotomy is the only conservative method of treatment in such cases. If a living child is diagnosticated just before or soon after the period of viability, Segond, Cragin, and others have urged the propriety of deferring operation for a few weeks in its interest. No doubt such a course may occasionally be permissible, but

it should not be undertaken unless the increased dangers of waiting are carefully explained to the patient and her family and accepted by them.

Generally speaking, immediate operation and ablation of the entire fetal sac is the ideal procedure, and in the rare cases of unruptured tubal or ovarian pregnancy may be comparatively simple, as the fetal sac may be excised without much greater difficulty than a large, adherent ovarian cyst. Unfortunately, such favorable conditions are not present in the majority of cases, as the fetal sac is usually densely adherent to surrounding organs, while the placental attachment may be spread over a broad area, thereby markedly increasing the difficulty of the operation.

In broad ligament pregnancy, when the portion of the broad ligament immediately adjoining the uterus is not spread apart by the growing ovum, the entire sac may be removed without great difficulty by following the suggestion of von Herff and ligating the vessels at the pelvic brim and at the uterine cornu before attempting to remove the sac. In many cases, however, its complete removal offers considerable difficulty, and can be effected only by removing the uterus as well. The technic of Kelly for hysteromyomectomy, designed especially for intraligamentous fibroid tumors, may be employed to great advantage in these cases.

Occasionally one feels that the removal of the sac cannot be attempted without seriously endangering the life of the patient. In this event it should be incised, taking care to avoid the placenta if possible, and the fetus extracted; after which its margins should be stitched to the abdominal opening and its cavity packed with gauze, leaving the placenta and the stump of the umbilical cord *in situ*. Under such circumstances the placenta is gradually cast off spontaneously and comes away piecemeal. This necessarily entails a prolonged convalescence, but is a far safer procedure than attempting to remove the placenta. This rule should always be adhered to except when partial separation of the placenta has already given rise to profuse hemorrhage, when its removal becomes imperative, no matter how dangerous it may appear. Those who are particularly interested in the treatment of the placenta in this class of cases are referred to the thesis of Lescuyer, in which the history of the subject is exhaustively considered. Likewise, when the placenta is broadly attached to the pelvic floor, and the fetal sac cannot be stitched to the abdominal incision, the immediate removal of the placenta is imperative, no matter how serious it may appear.

The results following primary laparotomy in advanced extrauterine pregnancy with a living child have markedly improved since the introduction of aseptic methods of operating. This is clearly shown by the statistics of Harris, who in 1887 reported a mortality of 93 per cent. in 27 cases collected from the literature, as compared with 31 per cent. in 145 cases which had been operated upon in the ten years following his first report. Moreover, a series of 148 cases operated upon since 1880, and collected by Ayers, shows a mortality of 40.4 per cent. Notwithstanding this marked improvement, it is nevertheless evident that the operation is probably the most dangerous one which gynecologists are called upon to perform; though doubtless improved technic will gradually result in a still further diminution of its dangers.

On the other hand, when the fetus is dead the conditions are much more favorable for operation, as the danger of hemorrhage from the placental site rapidly diminishes. Therefore the operation should be deferred, if possible, for six or eight weeks after the death of the fetus, in order to permit the obliteration of the maternal blood spaces in the placenta, which usually occurs within that time, when it is usually possible to peel off the placenta without great hemorrhage, and to close the abdomen without drainage. Of course, if dangerous symptoms should supervene while one is waiting for the obliteration of the placental circulation, immediate operation becomes imperative. In any event, the operation should not be delayed more than a few months after the death of the fetus, on account of the possibility of the infection of the fetal sac from the intestinal tract, and subsequent suppuration and peritonitis. Lusk, in 1888, made an earnest plea for prompt operation in such cases, and supported his contention by a large array of statistics.

In a small number of cases of this character operation by the vaginal route has been advocated, but I believe that its field of usefulness is very limited, as I agree with Herman and Segond that it should never be resorted to unless the fetus is firmly impacted in the pelvic cavity, and depresses the vaginal vault to such an extent as to make it appear probable that it can be removed without great difficulty. In all other cases, however, laparotomy is the operation of choice.

It is interesting to note that the first vaginal operation for extrauterine pregnancy in this country was performed in 1816 by Dr. John King, of Edisto Island, S. C., when a full-term child was removed after cutting through the posterior vaginal wall.

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CHAPTER XXXI.
DISEASES OF THE FEMALE BREAST.

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INTRODUCTION.

This contribution is based upon a clinical and pathologic study of 1048 lesions of the female breast which have been observed in the surgical pathologic laboratory of the Johns Hopkins Hospital and University. The majority of patients were treated in the surgical clinic of Professor Halsted.

When comparative figures as to results are given, only the cases admitted to the Johns Hopkins Hospital surgical wards are considered.

The problem in the treatment of every lesion of the female breast is the early recognition of carcinoma and its removal by the so-called complete Halsted operation.

In females under twenty-five years of age the probabilities are that every single tumor in the breast is benign. It is safe, therefore, to consider a tumor in a woman under twenty-five benign until it is proved to be malignant. On the other hand, every single tumor in the breast of a woman over twenty-five should be considered malignant until it is proved to be benign.

The public should be educated to know that cancer of the breast is, in its onset, a local disease curable by a complete excision; that many palpable masses in the breast are not cancer and can be removed without loss of the breast and without mutilation. If women can be educated to seek advice the moment their attention is called to a tumor in the breast, to a discharge from the nipple, to any change in the skin or nipple, then all lesions can be subjected to proper treatment at a period most favorable for the cure of cancer and for the removal of non-malignant tumors without mutilation.

Clinically all lesions of the breast can be divided into two groups: the first, *clinically malignant*; the second, *clinically doubtful*. When the surgeon is able, from the clinical history and examination, to recognize a cancer of the breast, he should proceed at once with the complete operation. The pathology of the tumor is subjected to examination only after its removal. On the other hand, when it is impossible to conclude that the tumor is malignant, one is not justified in doing the complete operation without a positive diagnosis. This can be done only by exploring the palpable mass with the knife and deciding the nature of the tumor from the gross appearance or a rapid frozen section (preferably the former). If it is malignant, the wound is cauterized, closed, and the complete operation performed. If

the tumor is not malignant, one removes the tumor, the entire breast, or both breasts, according to the nature of the benign lesion and the condition of the surrounding breast.

During the age in which cancer of the breast is observed practically every benign lesion may appear. For this reason, as long as a tumor of the breast has *not* assumed the clinical picture of malignancy any benign lesion is possible. The earlier women seek advice after the onset of the first symptom of a disease of the breast, the more frequently tumors will be observed by surgeons in that state in which a diagnosis can be made only at the exploratory incision.

My own experience demonstrates that if the exploratory incision into such early carcinoma, clinically doubtful, is followed immediately by the complete operation, the probabilities of a cure are not diminished.

From my observations on specimens sent to the surgical pathologic laboratory every patient has succumbed to carcinoma if at the first operation only the malignant tumor was removed, and then later, after a microscopic diagnosis, the complete operation was performed.

It is the object of a contribution of this character to confine itself strictly to the two great practical problems: *first*, the clinical picture which will allow a diagnosis of carcinoma, and justify the complete operation without an exploratory incision; *second*, to give a clear description of the gross appearances of the benign and malignant lesions of the breast, so that they can be recognized at the exploratory incision when a positive clinical diagnosis cannot be made.

Surgeons, therefore, must be their own pathologists. At the present time, in the majority of surgical clinics, a clinical diagnosis of cancer can be made in 90 per cent. of cases. The gross appearance of a malignant tumor in the breast which cannot be diagnosed clinically does not differ at all from the tumor which, on account of its infiltration, has assumed the picture which allows of a clinical diagnosis. For this reason surgeons will have at least nine opportunities to familiarize themselves with the fresh appearance of cancer after the complete operation has been performed, and so be prepared for the one case in which an exploratory incision must be done. As the majority of benign tumors occur in women under twenty-five, at an age in which cancer is almost unique, surgeons will have an opportunity to learn the fresh appearance of such innocent neoplasms, and thus be prepared to recognize them when they are met with at the exploratory incision into the breast of an older woman.

I feel quite certain that, in the great majority of cases, this differential diagnosis is not difficult. There are exceptions which require great experience. Until surgeons acquire this experience, I believe, the greatest good will be accomplished by performing the complete operation in all cases in which, at the exploratory incision, the surgeon is unable to convince himself that the tumor is benign.

The only harmful result of a complete operation for a benign lesion is mutilation, while an incomplete operation for carcinoma is practically fatal.

GENERAL ANATOMIC AND HISTOLOGIC REMARKS.

The mammæ may be looked upon as specially developed glands of the racemose variety from the epidermis. The breast, in its development and life history, may be studied in the following stages: the infantile breast, puberty hypertrophy, lactation hypertrophy, the normal breast, the senile breast.

The **infantile breast** (Fig. 431) is composed of a number of branching ducts surrounded by loose connective tissue; the ducts unite, a certain number pass into the nipple, and have openings through the epidermis. These ducts are lined by cuboidal epithelium. The entire breast is surrounded by subcutaneous fat. The breast, therefore, at birth, consists of a nipple covered with epidermis, differing from normal skin, surrounded by another zone of epidermis, the areola, which later becomes pigmented, and branching ducts held together by a loose connective-tissue stroma surrounded by fat.



FIG. 431.—BREAST OF EMBRYO DISSECTED TO SHOW DUCTS (Billroth).

Puberty hypertrophy is physiologic. The nipple becomes larger, more vascular, and sensitive; the zone of areolar epidermis wider, more pigmented; and beneath this epidermis special glands appear. From the ducts epithelium-lined acini originate by bulbous outgrowths (Fig. 432). In addition to this epithelial hypertrophy there is a development of new connective tissue about the ducts and acini—the *intralobular stroma*. The relation of this stroma to the ducts and acini resembles that of a sheath of Schwann to the axis-cylinder of a nerve. In this intralobular myxomatous connective tissue the principal lymphatics and blood-vessels are situated, radiating from the nipple throughout the breast and connecting the breast tissue with the skin above, the pectoral fascia, deeper structures of the chest wall, chest, and axilla.

The Normal Breast.—When puberty hypertrophy is established we may look upon the result as the normal breast. Histologically (Fig. 433) there are three important structures—the *parenchyma* (ducts and acini); the *intralobular stroma*, the envelope of the parenchyma, and the *interlobular stroma*. The epithelial cells of the ducts and acini have uniform morphology, and the basal cell is arranged definitely on a basement membrane; surrounding this there is a narrow zone of intralobular stroma, the parenchyma, and this stroma is arranged after a definite plan which may be looked upon as the architecture of the normal breast.

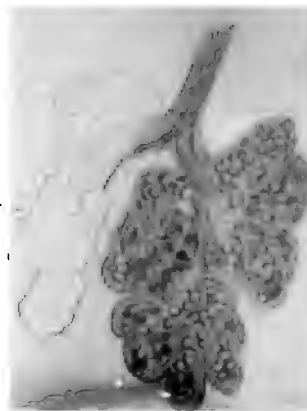


FIG. 432.—PUBERTY HYPERTROPHY, DUCTS AND ACINI (Billroth).

The gross appearance of the normal breast is quite characteristic. If a section is made through the breast from nipple to pectoral fascia, one sees a fan-shaped mass of tissue separated from the skin by a zone of subcutaneous fat, except at the nipple. This tissue is opaque, white in color. Projecting from its cut surface one can make out minute elevated dots of a pinkish color which are arranged in groups (Plate I, Fig. 1); near the nipple cross and longitudinal sections of minute cavities (ducts) may be made out (Fig. 434). In the breast of a young woman after puberty one seldom sees fat within the zone of breast tissue, and there is no fat between the base of the breast and the pectoral fascia. The breast has no distinct capsule, but in younger

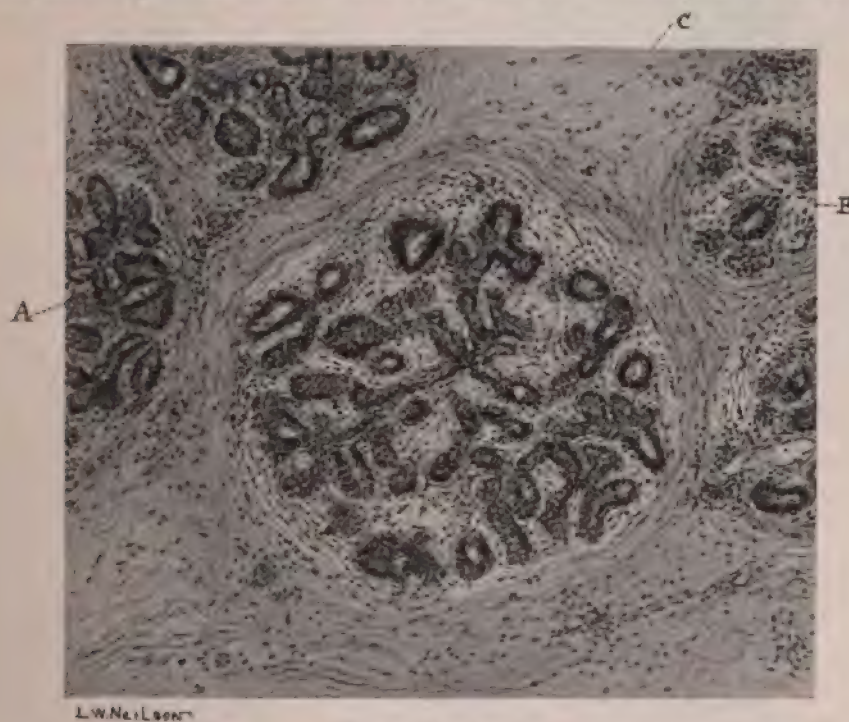


FIG. 433.—NORMAL BREAST.

A, parenchyma; B, intralobular stroma; C, interlobular stroma.

women the breast tissue is sharply circumscribed from the surrounding fat and the pectoral fascia.

Lactation Hypertrophy.—Enlargement of the breast is observed in the second month of pregnancy. At this time the nipples become more prominent and the areola larger in area and more pigmented. A discharge from the nipple (colostrum) is observed in the beginning of the third month. The skin glands in the areola (glands of Montgomery) enlarge about this time and produce small, roundish elevations of the epidermis. Secretion of milk is not fully established until after the second day of the puerperium.

The epithelial hypertrophy of the breast associated with gravidity probably

begins in the early months of pregnancy and is fully developed at the birth of the child. The changes are chiefly an increase in the number of acini and the characteristic development of each acinus. This epithelial hypertrophy is accomplished at

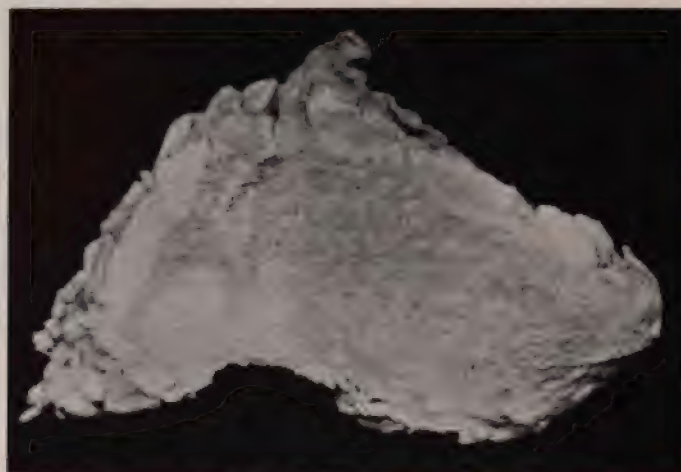


FIG. 434.—PUBERTY HYPERTROPHY.
Photograph from section of alcohol specimen.

the expense of the breast stroma. In the fully developed lactating breast (Fig. 435) the interlobular stroma has practically disappeared. Each lobule is made up of a group of acini surrounded by the intralobular stroma, in which the lymphatic vessels and blood-vessels are larger than in the normal breast (Fig. 436). It is important

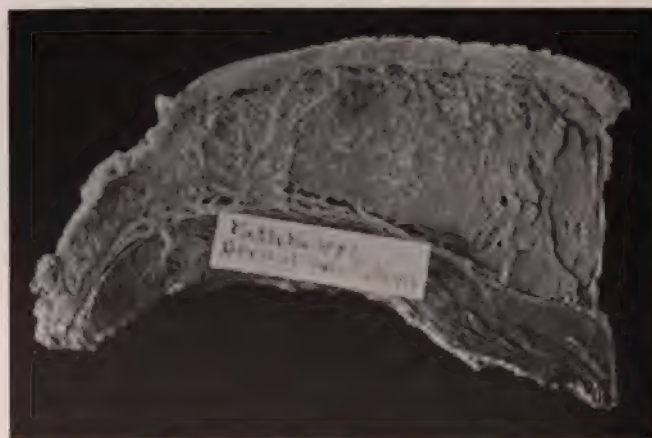


FIG. 435.—LACTATION HYPERTROPHY.
Photograph from section of alcohol specimen: skin, breast, muscle.

to remember that in inflammations of the breast the first changes are observed in the intralobular stroma. This is due to the fact that the lymphatic vessels begin at the nipple and follow the branching ducts to the terminal acini.

Senile Breast.—In women whose breasts have not been the seat of lactation hypertrophy, senile changes take place early—between thirty and forty. This parenchymatous atrophy is observed later when the breasts have been the seat of one or more lactations.

The breasts in a well-nourished woman may retain their size. This is due to the substitution of adipose tissue. The chief atrophy takes place in the parenchyma and intralobular stroma; with the latter the lumen of the lymphatic vessels and blood-vessels decreases. In the fully developed senile atrophy one sees, radiating from the nipple (Fig. 476), a few bands of fibrous tissue surrounded by more or less fat, according to the size of the breast. Microscopically (Fig. 457), the intralobular stroma has disappeared, and here and there in the fibrous interlobular stroma one can see the remains of a duct or acinus lined by epithelial cells which are very much smaller than normal, take the stain faintly, and may have lost their arrangement on the basement membrane.

GENERAL REMARKS ON THE CLINICAL PICTURE AND DIAGNOSIS.

I have divided breast lesions into two groups. In the first, one is able, from the history and examination, to make a diagnosis of a malignant tumor (*clinically malignant tumors*).

In the second group, one is unable to make such a diagnosis, and an exploratory incision is indicated to establish the nature of the lesion (*clinically doubtful tumors*).

The diagnosis of a malignant tumor is based upon the palpation of the tumor and the surrounding breast, changes in the skin and subcutaneous fat, and the changes in the nipple.

When the nipple, skin, and subcutaneous fat are apparently unchanged, it is very difficult to recognize a malignant tumor by palpation only. However, as one's experience increases, one will find that a positive diagnosis of a carcinoma can, in some instances, be made with certainty from the palpation of the tumor. The carcinoma has a characteristic hardness and irregularity in outline. When the tumor is buried in breast tissue, and the subcutaneous fat is thick, the palpating finger does not reach the neoplasm, and only feels it through fat and breast tissue. It is in such cases that the benign and malignant mass cannot be differentiated, and an exploratory incision becomes necessary. When the malignant tumor has reached the surface of the breast it, as a rule, can be distinguished by the experienced hand by palpation alone. Measurements of the diameters of the different quadrants of the breast are an aid in diagnosis (Fig. 437). A shortening of the diameter of the quadrant in which the tumor is situated is a strong evidence of carcinoma.

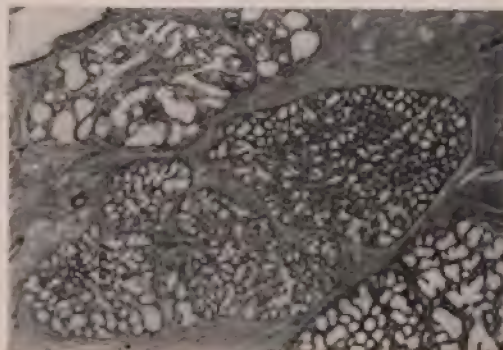


FIG. 436.—LACTATION HYPERTROPHY.
Microscopic drawing by Horn.

The palpation of definite *infiltration of the breast* about a more or less circumscribed tumor may be looked upon as positive evidence of its malignancy.

Retraction of the nipple (Fig. 512) is a pathognomonic sign of carcinoma. This may be visible on inspection. In other cases, if the surgeon pulls the nipple forward, its fixation to the deeper structures of the affected breast as compared with the nipple of the opposite breast will allow a positive diagnosis. This early change in the nipple is a very important sign, to be carefully investigated. One must remember the possibility of congenitally depressed nipples, and also that a previous lactation mastitis, with or without abscess, may have caused the nipple of the affected breast to become retracted. In my own experience there never was any difficulty in excluding these possibilities.

Certain *changes in the skin and subcutaneous fat* over the position of the palpable tumor are as positive signs of carcinoma as retraction of the nipple. The definite

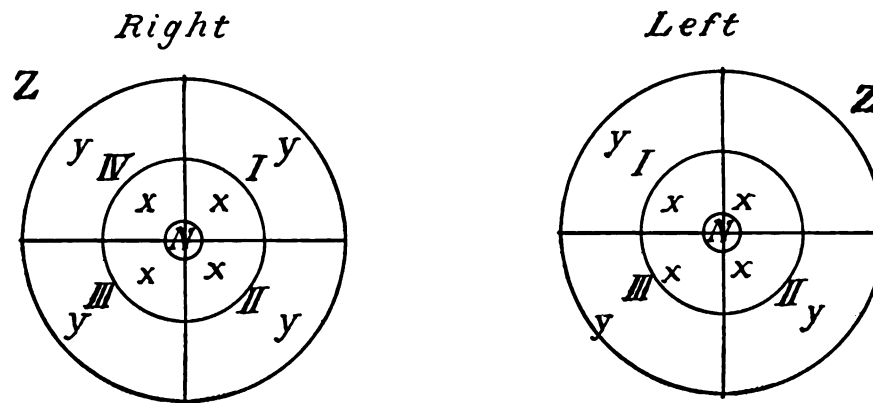


FIG. 437.—DIAGRAM FOR CHARTING POSITION OF TUMORS OF THE BREAST.

N, Nipple zone; x, central zone; y, peripheral zone; Z, axillary prolongation; I, upper and inner; II, lower and inner; III, lower and outer; IV, upper and outer quadrants.

changes which can be recognized by inspection or palpation need little discussion. Dimpling, adherent skin (Fig. 511), ulceration, and fungus formation (Fig. 504) require little experience to interpret as pathognomonic evidence of a malignant tumor. It is the first very slight changes, brought out by palpation only, that require experience to interpret, and, if understood, will allow a positive diagnosis of carcinoma. The least atrophy of the subcutaneous fat over a moderately small tumor is a sign of cancer. If the surgeon picks up the skin over the area of the tumor and can demonstrate shortening of the fibrous trabeculae, this can be looked upon as a sign of cancer. This shortening of the trabeculae can be demonstrated in some cases, when all other means fail, by grasping the breast with two hands and pushing forward the area of the breast containing the tumor. If the lesion is benign, the skin between the hands will bulge; if it is malignant, in some cases, the trabeculae will produce one or more dimples (Fig. 507), a positive sign of cancer.

If the breast containing the tumor is drawn closer to the chest wall than the un-

affected breast, this may be looked upon as a sign of cancer. Up to the present time I have never observed a case in which the diagnosis rested upon this sign alone, as other evidence of carcinoma has always been present.

In my experience palpable glands in the axilla are of no aid in the early recognition of a breast carcinoma. When these glands are sufficiently large and hard to allow a diagnosis of metastatic carcinoma, there will be no difficulty in the diagnosis of the primary tumor. Palpable glands in the axilla are frequently observed in benign tumors and inflammations.

In the **clinically doubtful** tumor there is present but one sign—a palpable mass. There are absolutely no changes to be demonstrated in the nipple, skin, subcutaneous fat, or surrounding breast. This mass may feel distinctly encapsulated, an almost positive sign of a benign tumor. Nevertheless, some malignant, solid, and cystic tumors may give to the palpating fingers a sense of encapsulation. The mass may feel circumscribed, but not encapsulated. This suggests, but is not positive evidence of, carcinoma. If the benign encapsulated tumor is buried in breast tissue, one will feel the mass as a circumscribed area; encapsulation cannot be made out. The mass may be diffuse. This suggests carcinoma, but some benign lesions are diffuse; mastitis, senile parenchymatous hypertrophy, and a small encapsulated benign tumor (solid or cystic), if buried in breast tissue, may feel like a diffuse area of induration.

When there is nothing but tumor on which to base the diagnosis, one may be, in a certain number of cases, sufficiently positive of its malignant nature from palpation alone to proceed with the complete operation without an exploratory incision. In all other cases one explores the tumor. In quite a number one may feel quite confident of its benign nature. However, the possibility of exposing an early carcinoma whenever a tumor of the breast is explored must always be borne in mind. *For this reason the operation should be performed with all preparations for the complete operation for carcinoma.*

Pain, discharge of blood from the nipple, and fluctuation have not been mentioned prominently among the differential signs in the diagnosis between a benign and malignant neoplasm. *Pain* is not a sign of cancer; as a rule, it is more often the symptom of onset of a benign than a malignant tumor, and usually a late symptom in cancer. *Discharge from the nipple* is observed in the infantile breast, during lactation, in senile parenchymatous hypertrophy, and is associated with cysts containing an intracystic papilloma, when the discharge is usually hemorrhagic. The presence of the discharge, however, does not exclude a carcinoma in the last two lesions, which frequently become malignant. Fluctuation is often a misleading symptom; it is observed in solid tumors and cysts, either benign or malignant. The absence of fluctuation does not exclude a cyst; there is none when the cyst is tense.

Local edema of the skin and subcutaneous fat about the palpable tumor in a few cases allowed a positive diagnosis of cancer when there were no changes in the skin or nipple for further aid. This edema is observed in very rapidly growing

malignant tumors and, from the standpoint of prognosis, has so far been associated with a fatal end result.

Skin Metastasis.—On a few occasions, when a positive diagnosis could not be made of the exact nature of the palpable tumor, the presence of two or more lenticular, shot-like nodules in the skin of the breast could be interpreted as positive signs of carcinoma. As a rule, skin metastases appear after the tumor has assumed a clear picture of malignancy. Up to the present time there has not been recorded a single case of permanent cure when skin metastases were present.

General Metastasis.—With the exception of the skin metastases just noted I have never observed a patient with evidence of general metastasis before the primary tumor in the breast had assumed the picture of malignancy.

Cachexia and Change in the General Health.—In my experience the general condition of the patient has never been of any aid in the differential diagnosis of single tumors of the breast. On three occasions multiple tumors in both breasts associated with cachexia suggested metastatic sarcoma, which proved to be correct.

Multiple Tumors.—Carcinoma of the breast, for practical purposes, is unicentric in origin. It first appears as a single mass. On a few occasions carcinomata have appeared simultaneously in both breasts. Now and then patients have given the history of feeling first one lump, then another, which later coalesced. In the few cases of malignant tumors of the breast in which I could palpate more than one nodule, one has always been clinically malignant.

Multiple tumors in one or both breasts which clinically have assumed none of the characteristic signs of cancer may be looked upon as benign. In a woman under twenty-five they are usually intracanalicular myxomata. The adenofibroma is less frequently multiple. I have observed a few cases both in younger and older women. Multiple tumors in one or both breasts in women over thirty, and especially between forty and fifty, are, with rare exceptions, simple cysts, associated with some stage of senile parenchymatous hypertrophy. Cystic adenoma may be multiple; it is a rare tumor, and those tumors which I have seen were in women over thirty. Senile parenchymatous hypertrophy without cyst formation now and then appears as multiple nodular masses in one or both breasts. The caked breast, in the early stage of lactation, or mastitis, in the later stage, may be multiple.

Metastatic sarcoma may present the clinical picture of multiple tumors of one or both breasts, and, in the early stage, offers no general evidence of malignant disease. If the primary tumor is concealed, for example, in the ovary, a differential diagnosis may be impossible until one of the tumors is exposed.

Cysts with intracystic papillomatous growths have been observed as multiple tumors. None, so far, has come under my observation.

In women, under twenty-five, suffering from multiple tumors of one or both breasts operation is not indicated unless one or more of the tumors is giving sufficient pain or exhibiting enough growth to justify its local removal. In my experience this rarely takes place.

On the other hand, multiple tumors in women over twenty-five should be ex-

plored in order that a positive diagnosis of their nature be made. The treatment of these various multiple tumors will be discussed later.

Important Facts to be Ascertained in the History of a Breast Tumor.—

Practically the diagnosis of a breast tumor must be made upon the examination of the tumor, breast, skin, and nipple. With rare exceptions only can the details obtained from the patient as to the history of the growth be utilized for diagnostic purposes.

Age.—If the patient is under twenty-five, this fact alone is presumptive evidence of a benign lesion, but carcinoma has been observed in women under twenty-five. If the patient is over twenty-five, the tumor, on the theory of probability, will in the majority of cases be a carcinoma; but practically all forms of benign lesions are possible in older women.

The long *duration* of the tumor, without any positive evidence of malignancy, points to a benign lesion; nevertheless there are too many exceptions to allow this alone to exclude a malignant tumor.

An area of induration during lactation, in the great majority of cases, is due to pyogenic mastitis. Carcinoma, however, has been observed in the lactating breast, and in its early stage cannot be differentiated from mastitis.

Position of Tumors of the Breast.—Fig. 437 illustrates how the breast may be divided into four quadrants, and how each quadrant may be subdivided into the nipple, middle and outer zone, and axillary prolongation. I am unable to find that the position of the tumor is of any aid in differential diagnosis. Benign tumors, except the papillomatous cysts, are rarely observed in the nipple zone. Mastitis, unless tubercular, occurs chiefly in the outer zone. Scirrhus carcinoma is quite frequent in the nipple zone. All tumors, except cancer cysts, occur most frequently in the upper and outer quadrant. In carcinoma, next to this quadrant, the nipple zone is the most frequent position. Benign and malignant tumors may be situated in any portion of the breast. Cancer has been observed in the axillary prolongation in about 10 per cent. of the cases; benign tumors, with equal frequency. Between the right and left breast there is not enough difference to be at all suggestive. In my own figures the number of tumors in the left breast is slightly in excess. Cancer in both breasts has been observed in about 5 per cent.

Palpable tumors have been present in the breast from ten to twenty years, remaining quiescent, and then taking on rapid growth. In some the tumor proves to be malignant, in others a benign cyst. Of great interest are all the facts in regard to the onset of the tumor, its duration, etc., but my experience teaches me that it is dangerous to place chief reliance on these facts in the differential diagnosis. This evidence should be obtained with great care, and used, as far as possible, in the differential diagnosis of the clinically doubtful tumors. If the tumor on examination has the signs of cancer, evidence from the clinical history must be given no weight.

If the rule is followed to explore at once every single tumor in which a clinical diagnosis of carcinoma cannot be made, the diagnosis must in the end rest upon the appearance of the fresh tissue or the frozen section.

The facts of importance to be obtained from the history may be summarized as follows: The history of malignant tumors in the family; the possibility of tuberculosis in the family or evidence of tuberculosis elsewhere in the patient. A very small proportion of patients give a family history of malignant tumors. The great majority of cases of tuberculosis of the breast give negative family histories and have no evidence of tuberculosis elsewhere. The possibility of a syphilitic infection should be borne in mind, especially as to primary lesions of the nipple. Gumma and luetic mastitis are very unusual occurrences in the breast.

The *age of onset* is perhaps the most important fact. The only lesion of the infantile breast is ectasia of the ducts with a discharge from the nipple. This may be associated with pyogenic mastitis. From infancy to the period of puberty hypertrophy the breast is practically immune from disease. At and after puberty the fibro-epithelial tumors appear (the intracanalicular myxoma and the adenofibroma). These tumors, although apparently originating during puberty hypertrophy, may not exhibit growth until later. This explains their apparent onset in women between twenty-five and forty-two. During the menopause, which in the majority of women takes place between forty and fifty, senile parenchymatous hypertrophy and simple cysts are very frequent. After the menopause the possible tumors are carcinoma, sarcoma, and simple cysts, with the probability greatly in favor of carcinoma.

Carcinoma is distinctly a disease of the senile breast, but it may occur before senile changes take place, and even during lactation hypertrophy. It is possible up to the end of life. In women under thirty carcinoma is very rare. The preponderance of cases is observed in women over forty.

The Duration of the Tumor.—In a table of forty-nine cases in which the malignant tumor had assumed no positive evidence of its malignancy, I find that the duration of the tumor, with rare exceptions, has been one year or less. A tumor which has been present one year or more and still manifests no positive evidence of malignancy will, in the majority of cases, probably turn out to be benign. However, we have observed a small infiltrating scirrhous of five years' duration and an adenocarcinoma of two years' duration, still clinically doubtful, and since at the present time women should consult surgeons, as in the majority of cases they do, before the end of the year, the duration of the tumor becomes of less and less importance.

Trauma has not been an important etiologic factor in the history of either benign or malignant tumors of the breast.

Lactation Hypertrophy.—During pregnancy an induration of the breast should be explored at once; with rare exceptions it will prove to be either tuberculosis or carcinoma. During the first four months after lactation pyogenic mastitis is the common lesion. After the fourth month a mass in the breast should be regarded as very suspicious of carcinoma.

Lactation mastitis, with or without abscess formation, usually leaves no palpable residual scar tissue, and apparently plays no part as an etiologic factor in the development of a later carcinoma. However, if a palpable mass remains after a lactation mastitis, with or without abscess, such a mass should be regarded as suspicious. In

my experience carcinoma may eventually develop, sometimes not until after a free interval of thirty years.

The symptoms of onset in tumors of the breast are: tumor, pain, retraction of nipple, dimpling of the skin, discharge from the nipple, and palpable axillary glands. In the majority of cases tumor is the symptom of onset. In a few, pain may precede the appearance of the tumor by days, weeks, or months. Persistent localized pain in the breast should make one suspicious of a tumor formation. I have never explored the breast for pain only. Pain is not a symptom of malignant tumor. It is more common in benign lesions, and may be an early symptom, or the symptom of onset, especially in cysts, senile parenchymatous hypertrophy, and fibroadenoma. It is a late symptom in cancer. Retraction of the nipple may be looked upon as pathognomonic of cancer. It is rarely the first symptom. I have observed it but once without a palpable tumor, and in this case the exploratory incision revealed a small infiltrating scirrhous. Dimpling of the skin in a few instances has been the first sign observed by the patient. In all of my observations a tumor could be felt. A discharge from the nipple, except during lactation or pregnancy, may be looked upon as a sign of a benign lesion and not a symptom of cancer. If the discharge is blood or a cloudy serum, this is a positive sign of a cyst with an intracystic papillomatous growth. In these cases such a discharge is frequently observed by the patient for months or years. In senile parenchymatous hypertrophy one can sometimes express from the nipple a thick, brownish material—the accumulation of degenerated, desquamated epithelium in the dilated ducts. The patient seldom observes this. In a few cases the patients observed palpable glands in the axilla before they felt the tumor. I have never observed large palpable glands in the axilla without finding the tumor in the breast. I do not look upon palpable glands as an aid in the differential diagnosis of tumor of the breast. If the glands are large or hard enough to be of themselves diagnostic of cancer, the tumor is also clearly malignant, clinically. Palpable glands of a non-malignant nature are so frequent in the axilla that their presence or absence cannot be utilized as evidence for or against the malignant nature of the palpable tumor in the breast.

Eczema of the nipple as a symptom of onset I will discuss later under Paget's disease.

Marked uniform enlargement of both breasts in a young woman is a positive evidence of the virginal, diffuse hypertrophy. If observed during gravidity, it is the same disease.

Symmetric enlargement of one breast in the female is due to tumor formation, usually benign, and most likely to be intracanalicular myxoma. In some instances it has been due to adenofibroma.

Unilateral atrophy of the breast in older women in my experience has always been associated with a palpable, scirrhous tumor (atrophic scirrhous). In younger women unilateral atrophy may follow lactation mastitis.

CLASSIFICATION OF LESIONS OF THE FEMALE BREAST.

The following classification is based upon a clinical and pathologic study of 1048 lesions of the breast of which I have records in the surgical pathologic laboratory. Of these, 597 were carcinoma, 18 sarcoma, and 333 benign lesions. The relative proportion of cases observed in Halsted's clinic of the Johns Hopkins Hospital is as follows:

Carcinoma.....	464 cases = 67 %
Sarcoma.....	14 cases = 1.5%
Benign lesions.....	216 cases = 31.5%

- I. Anomalies.
- II. Symptomatic lesions.
 - (A) Pain (neuralgia of breast, mastodynia).
 - (B) Areas of congestion (phantom tumors).
- III. Hypertrophies.
 - (A) Infantile (duct ectasia).
 - (B) Puberty hypertrophy (normal).
 - (C) Lactation hypertrophy (physiologic).
 - (D) Diffuse bilateral hypertrophy (pathologic).
 - (E) Senile parenchymatous hypertrophy, with and without cyst formation.
- IV. Inflammations (mastitides).
 - (A) Pyogenic, with abscess formation.
 1. Associated with lactation.
 2. Not associated with lactation.
 - (B) Chronic interstitial, with parenchymatous atrophy and without cyst or abscess formation.
 - (C) Tuberculosis.
 - (D) Syphilis.
- V. Benign Tumors.
 - (A) Non-indigenous: lipoma, enchondroma, lymphangioma, dermoid cysts, calcium deposits, encysted foreign bodies.
 - (B) Fibroepithelial tumors:
 1. Intracanalicular myxoma (periductal myxoma, or fibroma—Warren).
 2. Adenofibroma.
 - (C) Epithelial tumors.
 1. Adenoma (cystadenoma).
 2. Cysts with intracystic papilloma.
 3. Simple cyst, single or multiple (see senile parenchymatous hypertrophy).
 4. Galactocele (see lactation hypertrophy).
- VI. Malignant Tumors.
 - (A) Carcinoma.
 1. Adenocarcinoma.

2. Medullary carcinoma.
3. Scirrhus carcinoma.
4. Cancer cysts.
- (B) Sarcoma.
 1. Secondary to intracanalicular myxoma.
 2. Non-indigenous

ANOMALIES.

These rare lesions are fully considered by Billroth,¹ Roger Williams,² and Sheild.³ Complete absence of one or both breasts or nipples is very rarely observed. The presence of more than two breasts or nipples (polynazia), although infrequent, is relatively more common. The supernumerary breasts are usually near the normal breast or in the axilla. According to some authorities (Meckel von Hemsbach), there were originally in the human race the rudiments of five mammary glands—two on the thorax, two in the axillæ, and one in the median line, below the ensiform cartilage. Garre has observed a woman with five developed mammæ in these situations. Williams pictures diagrammatically seven pairs of milk glands, the first in the upper axillæ, the seventh in the lower abdomen.



FIG. 438.—OVARIAN CYST CONTAINING A DEVELOPED BREAST (Sheild).

Lesions of the supernumerary breasts should be treated on the same principles which apply to the normal breast. I should advise the excision of supernumerary breasts or nipples, even though there be no evidence of disease.

Aberrant breast tissue is apparently rare. I have observed three cases of adenofibroma situated outside of the breast, which may be looked upon as tumor formation in, or hypertrophy of, aberrant breast tissue. I have never observed a malignant tumor of aberrant breast tissue.

Of interest to gynecologists is a specimen, in the Royal College of Surgeons in London, of an ovarian cyst containing a mammary gland (Fig. 438).

SYMPTOMATIC LESIONS.

Localized pain has been referred to. Neuralgia of the breast (mastodynia) is an unusual condition, without tumor formation. I have observed but two definite cases which were followed sufficiently long to exclude a tumor. Myalgia of the pectoralis major muscle, due to strain, contusion, or of metastatic origin, similar to the so-called rheumatic pains in the joints, may simulate localized pain in the breast.

¹ Loc. cit.

² Williams, Roger: "Diseases of the Breast," London, 1894.

³ Sheild: "Diseases of the Breast," London, 1898.

I have records of about ten cases, in all of which tumors could be excluded, and subsequent events have proved the correctness of the diagnosis.

In young women, especially young married women, who have not borne children, one or more painful areas in the breast are sometimes observed, especially during the menstrual period. When the breasts are examined the painful area usually has a firmer consistence than the rest of the breast. When there is but a single area, it may give rise to the suspicion of a tumor. In my experience such an area will not be found to persist after menstruation is over. On one occasion Finney explored under cocain anesthesia a case of this kind. There was no tumor, and the microscopic study of the piece of breast removed was negative. This patient has been observed for five years and no tumor has developed, nor was there trouble during lactation. In a similar observation Halsted etherized his patient for exploration, but under the narcosis the palpable area disappeared; nothing was done. It is seven years since this event, and no tumor has developed. Noble tells me that gynecologists frequently see painful areas in the breast coincident with menstruation. I look upon these areas as due to congestion, and have called them phantom tumors. There should be no difficulty in recognizing them. In case of doubt where the patient is over twenty-five years of age I should advise exploration. During the menopause I am confident that the pain in one or more areas of one or both breasts, not infrequently complained of by women, is due to senile parenchymatous hypertrophy with minute cyst formation. These painful areas may be associated with palpable masses. (See p. 200.)

Discharge from the nipple may be looked upon as a symptomatic lesion; this I have discussed (p. 187).

HYPERTROPHIES.

Infantile hypertrophy, to which we have already referred, is due to ectasia of the ducts and to their distention with desquamated, degenerated epithelium. The cause of this epithelial activity is not known. It disappears spontaneously. During this disease the infantile breast is more prone to infection and mastitis, the dilated ducts acting as portals of entrance. The nipple of infants so affected should be protected. The first sign of infection should be followed by immediate incision. Delay in the prompt recognition and treatment is apt to be followed by multiple abscesses and general infection.

Puberty Hypertrophy.—This has been discussed on page 182. It is a physiologic process. During this period the fibroepithelial tumors, chiefly the intracanalicular myxoma, and diffuse virginal hypertrophy have their onset. Other diseases are rare. The hypertrophy may be defective. There is no treatment for its correction. It is during this period that the development of the nipples may not take place, a condition which, as a rule, gives trouble during lactation and, according to Warren, of Boston, is frequently associated with abnormal involution (senile parenchymatous hypertrophy) later in life at the menopause.

Lactation Hypertrophy.—This physiologic process has been discussed on page 183.

During pregnancy the breast is especially immune to pathologic processes.



FIG. 439.—GALACTOCELE OF RIGHT BREAST.

Colored girl, aged eighteen; tumor sixteen months; onset fifth month of pregnancy; lactation normal.

If a mass appears in the breast at this period, it should be explored. Carcinoma has been observed to develop.

Incomplete lactation hypertrophy is not uncommon. I know of no treatment



FIG. 440.—GALACTOCELE.

G, G, Galactocoele; L, lactating breast; F, fibrous breast; D, dilated duct. (See Fig. 439.)

for this faulty development. The diffuse bilateral hypertrophy most frequently observed in the virginal breast may occur in the breasts of a pregnant woman. Be-

nign tumors are rarely observed first during pregnancy or lactation, I have seen one case. In a few instances benign tumors present in the breast before pregnancy have been removed during lactation. In such cases the parenchyma of the benign tumor has shown lactation hypertrophy with milk secretion. Billroth first observed this. Two such specimens have been sent to the surgical pathologic laboratory. Lactation mastitis of pyogenic origin is usually observed before the fourth month. Any tumor or induration of the breast after the fourth month is usually due to tuberculosis or to carcinoma. For this reason there should be no delay in the exploration.

The galactocoele is a cystic tumor due to the dilatation of a duct, and is always associated with lactation. It may appear during pregnancy, most frequently during

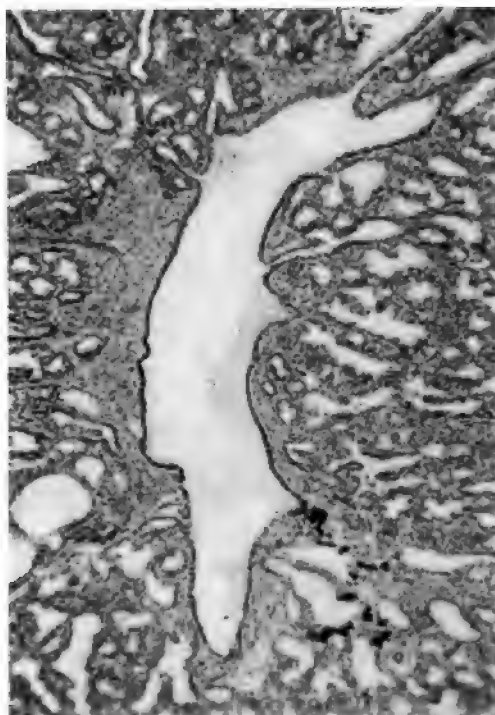


FIG. 441.—GALACTOCELE.

Dilated ducts surrounded by lactating breast. Photomicrograph by Wright.

lactation. In a few cases it is stated that the cyst did not appear until years after lactation. In my observation the tumor was discovered in the fifth month of pregnancy.

Clinically, the tumor is somewhat bottle-shaped, with the neck toward the nipple (Fig. 439); the skin and nipple are normal; fluctuation may be present. There may be multiple smaller tumors. At the exploratory incision there is a distinct thin-walled cyst with milk-like contents (Fig. 440). This cyst should be easily distinguished from that due to a chronic pyogenic abscess, or from a cancer cyst, both of which have been observed in the lactating breast. Conservative treatment is

justifiable. Microscopically (Fig. 441), about the dilated duct, breast tissue showing lactation hypertrophy will usually be found.

Diffuse Bilateral Hypertrophy.—This is always a bilateral disease. Apparent unilateral hypertrophy is due to tumor formation, usually intracanalicular myxoma.



FIG. 442.—DIFFUSE VIRGINAL HYPERTROPHY
Johnston's case.

This hypertrophy is most common in the young unmarried woman (virginal). It has been observed in a pregnant woman (gravity hypertrophy).

Clinically, there is uniform enlargement of both breasts. In the virginal type

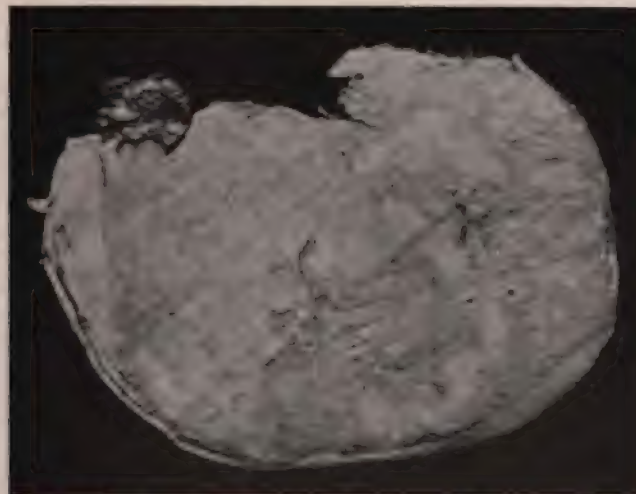


FIG. 443.—DIFFUSE VIRGINAL HYPERTROPHY.
Photograph from section of alcohol specimen. Johnston's case.

there is no tendency to spontaneous recovery. In the gravity hypertrophy spontaneous recoveries have been observed. In the virginal form there may be a slight discharge from the nipple. In that observed in gravity or lactation the milk secretion may not be interfered with.

There should be no difficulty in making a clinical diagnosis (Fig. 442). When a section is made through the breast (Fig. 443) the zone of subcutaneous fat is in-



FIG. 444.—DIFFUSE VIRGINAL HYPERTROPHY.
Photomicrograph by Wright.

filtrated by breast tissue; edematous fibrous stroma predominates, but the pink dots of parenchyma and sections of ducts will be seen; microscopically (Fig. 444) the

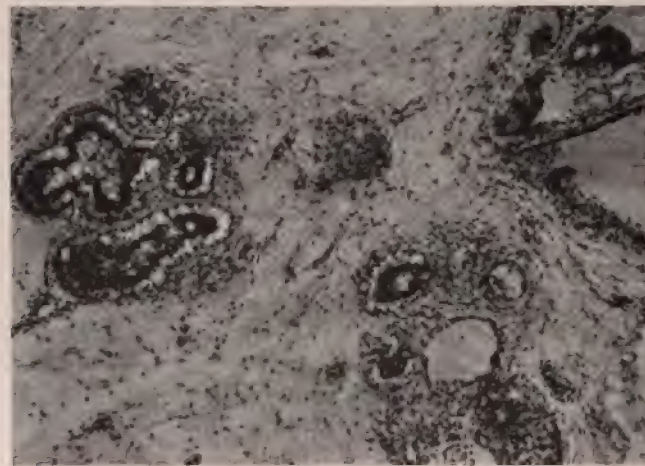


FIG. 445.—DIFFUSE VIRGINAL HYPERTROPHY
Photomicrograph by Wright.

chief part of the hypertrophy is due to a young cellular connective tissue. There is also an increase of the parenchyma. This is observed in a marked degree in the periphery, and the epithelial cells are of a higher type and show activity (Fig. 445).

The architecture of the normal breast is not preserved. Microscopically it resembles adenofibroma (Figs. 472, 473) and the diffuse hypertrophy of the male breast, which may be unilateral.

There are no symptoms except the weight of the tumor, and no treatment except



FIG. 446.—CARCINOMA IN DIFFUSE VIRGINAL HYPERTROPHY.

Photograph of patient from Halsted's clinic. Colored woman, aged thirty-eight; hypertrophy eleven years, tumor a few years, in right breast.

complete excision of both breasts when the discomfort is sufficient to justify this mutilation.

In the literature no cases of carcinoma are recorded in about forty cases. I have



FIG. 447.—SECTION OF BREAST AND TUMOR (THE LATTER CUT) FROM PATIENT IN FIG. 446.

Photograph from fresh specimen (Schapiro), showing diffuse virginal hypertrophy and scirrhous carcinoma.

observed two instances of carcinoma involving one breast, in which both breasts were the seat of the early stage of this hypertrophy (Figs. 446 and 447).

The age of onset in virginal hypertrophy has varied from eleven to thirty years, usually under twenty; the growth is slow, requiring from one to fourteen years. In gravidity hypertrophy the patients are older and the growth more rapid.

Senile Parenchymatous Hypertrophy¹ with and without Cyst Formation.—

This disease (25 per cent. of benign lesions) is the most important among the benign lesions of the breast. It occurs during the cancer age, and must always be differentiated from carcinoma at the exploratory incision.



FIG. 448.—SIMPLE SINGLE CYST IN A BREAST
THE SEAT OF EARLY SENILE HYPERTROPHY.
Photograph from painting by Horn.

The type in which the production of one or more simple cysts predominates is so distinctly a benign lesion, and shows so little, or no, tendency to become carcinoma, that conservative measures—local excision of one or more of the cysts—are justifiable.

Complete excision of the breast is done only when the mamma is riddled with cysts. The cystic form is frequently bilateral, and operations upon both breasts may have to be done—even the complete removal.

When one cyst is excised from a breast in which it is apparently the only lesion, it can be expected in a certain number of cases that the patients will return with another cyst in the same or opposite breast.



FIG. 449.—MULTIPLE CYSTS IN SENILE PARENCHYMATOUS HYPERTROPHY.
Photograph from alcohol specimen.

The fact that I wish to emphasize is that the development of one (Fig. 448) or

¹Also called chronic cystic mastitis (Billroth), abnormal involution (Warren), intra-acinous cystic epithelioma (Réclus), cystadenoma (Schimmelbusch), diffuse fibroadenoma (Wood), cystic disease of the breast (Bryant).

PLATE I.



FIG. 1.—FIBROADENOMA OF ACCESSORY BREAST TISSUE.
Pink elevated dots represent lobules of parenchyma. (Original, Bloodgood.)



FIG. 2.—SENILE PARENCHYMATOUS HYPERTROPHY, ADENOCYSTIC TYPE, WITH ADENOCARCINOMATOUS NODULE (X); N, NORMAL BREAST; C, MINUTE CYSTS; Ad, ADENOCYSTIC CHANGES.
Patient of Dr. Finney. Age thirty, no lactation; hypertrophy of outer hemisphere four months; excision of breast; well four and a half years. (Halsted's clinic.)

activity takes place in one or more areas of one or both breasts. In the first stage there is an increase of parenchyma (Fig. 450)—the adenomatous stage. The epithe-

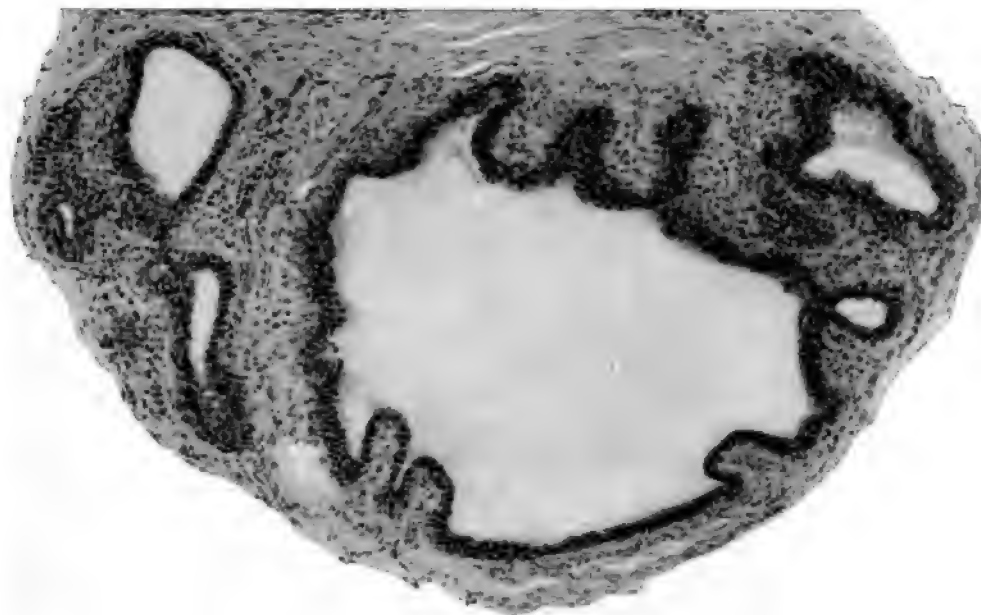


FIG. 451.—STAGE OF ECTASIA IN SENILE PARENCHYMATOUS HYPERTROPHY.
Microscopic drawing by Horn.

lial cells become of a higher type, proliferate, and degenerate. This is associated with dilatation of the ducts and acini—the stage of ectasia (Fig. 451).



FIG. 452.—CYST-FORMATION IN
SENILE PARENCHYMATOUS
HYPERTROPHY OR CYSTIC
ADENOMA.

X, Remains of epithelium lining
cyst (Horn).

Resolution may take place. It is a question whether there are any clinical signs of the hypertrophy up to this stage. Now and then women complain of pain in one or both breasts, and on palpation areas of increased density are felt. Observation shows that this may completely disappear, or later on positive evidence of further development of this hypertrophy takes place.

From the stage of ectasia further development takes place in two directions. One is the formation of cysts due to the further dilatation of an epithelium-lined cavity, and associated with the loss of its epithelial lining (Fig. 452). The fully developed simple cyst has no epithelial lining, the smaller cysts have (Fig. 453). Second, the epithelial lined cavities of the ectatic acini and ducts, instead of dilating and losing their epithelial lining, become filled with proliferating epithelial cells which form various cell combinations (Figs. 454 and 455). This is the adenocystic type.

The tendency in the cystic form is to complete degeneration of the epithelial cells. This may explain the apparent immunity from carcinoma, while in the adenocystic form there is unusual activity and preservation of the epithelial cells, which at any time may break through the basement membrane and infiltrate the stroma, giving rise to a carcinoma.

The observed facts support this histologic explanation.

Clinical Picture (One Tumor).—When there is but a single palpable mass, the diagnosis is generally doubtful, even if this mass has all the signs of a cyst. As long as the condition is benign there will be no clinical signs of a malignant tumor.

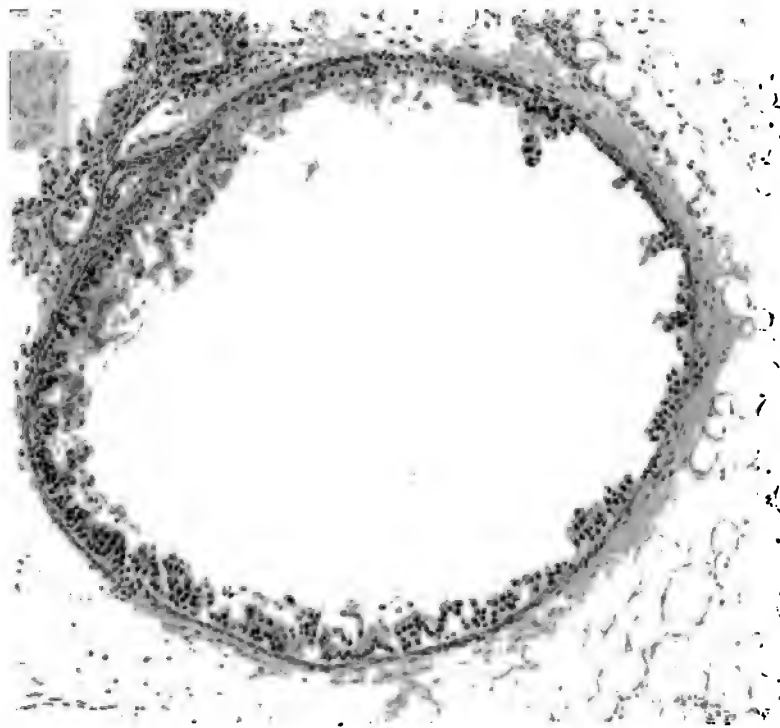


FIG. 453.—EPITHELIUM-LINED MINUTE CYST IN SENILE PARENCHYMATOUS HYPERTROPHY.
Microscopic drawing.

However, when the clinical picture is still doubtful, the pathologic process in the adenocystic type may have become malignant.

Clinically, the palpable mass appears in three distinct forms: a circumscribed tumor, an area of induration, and a definite enlargement of one quadrant or hemisphere of the breast.

The larger simple cyst gives rise to a definitely circumscribed encapsulated spherical tumor which may fluctuate (Fig. 456). In many cases one can feel through the skin and subcutaneous fat the smooth, tense cyst wall. The area of induration is due to one or more small cysts surrounded by fibrous breast stroma (Fig. 457).

Such an area may feel somewhat like a scirrhus carcinoma. The hypertrophy of a quadrant or zone is due to the adenocystic type of senile parenchymatous hypertrophy (Plate I, Fig. 2). The diameters of this area of the breast are increased. The enlarged zone of breast tissue is firmer in consistency than the remainder of the breast, has a rough surface, and minute shot-like bodies may be felt on its surface. In my experience one can be fairly certain, from the examination, of the presence of a cyst (Fig. 456) in a large number of cases, and the definite increase in the

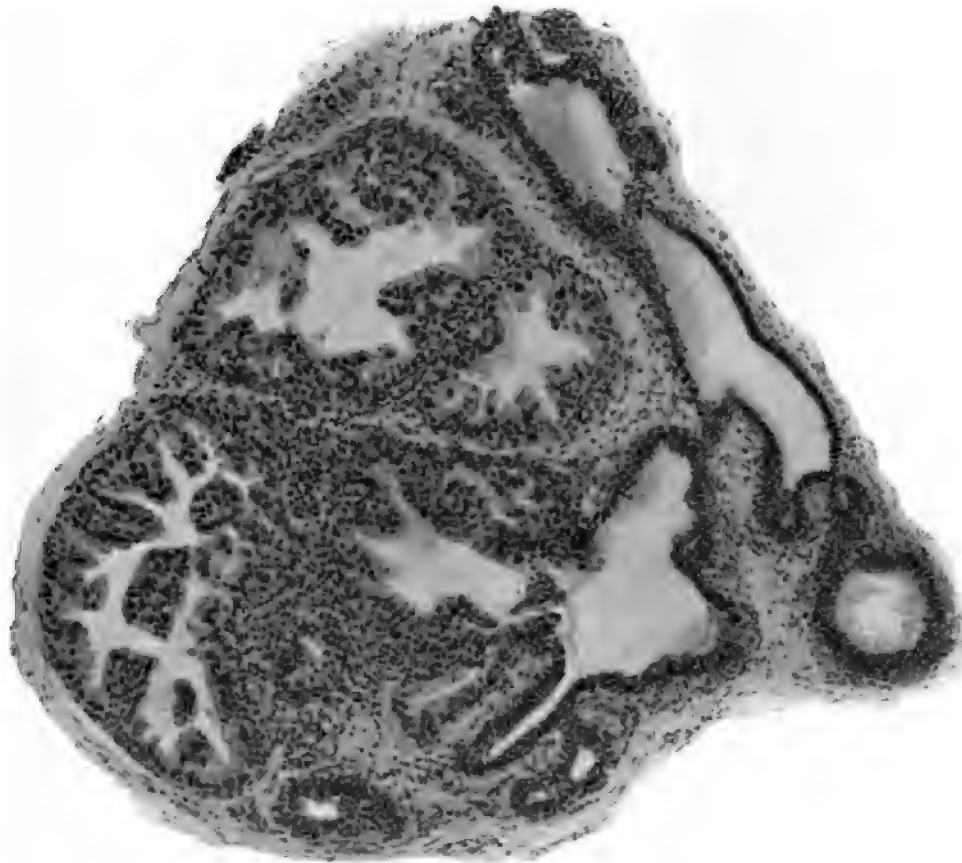


FIG. 454.—ADENOCYSTIC CHANGES IN SENILE PARENCHYMATOUS HYPERTROPHY AND CYSTIC ADENOMA.
Microscopic drawing by Horn.

diameters of a quadrant or hemisphere of the breast, associated with no change in the nipple, skin, or fat, may be looked upon as a pretty definite sign of the adenocystic type of this hypertrophy. But when the tumor feels like an area of induration, one cannot be certain that it is due to a cyst or a carcinoma until explored with the knife.

The cyst is usually spherical; a solid carcinoma never. A carcinoma involving a quadrant or hemisphere of the breast will be associated with changes in the skin and subcutaneous fat, and probably retraction of the nipple.

The age of the patient will be of no aid in diagnosis. This hypertrophy with or without cyst formation is usually observed between forty and fifty, before or during



FIG. 455.—ADENOCYSTIC AREAS (A) AND ECTASIA IN SENILE PARENCHYMATOUS HYPERTROPHY. Breast contained multiple cysts. Microscopic drawing.

the menopause. It may appear earlier, and I have observed a few cases under thirty.

In the cases in which the adenocystic type has become carcinoma (Plate I, Fig 2) the age of the patient has been between forty and fifty, with two exceptions, one thirty-six and one sixty. The duration of the tumor in cases in which the clinical diagnosis was still doubtful has been less than four months. The duration of the disease will be of aid in the clinical diagnosis.

The adenocystic type grows rapidly, and those cases which present a small area of induration are also of short duration.

In many of the cases of single, simple cyst the spherical circumscribed tumor has appeared rapidly, in a few days. I have observed four cases that developed within twenty-four hours. The history of such a rapid formation is almost a positive sign of simple cyst. On the other hand, there are a few observations in which the tumor has been observed from two to ten years, and now and then with the history of disappearing to reappear again. This historical



FIG. 456.—CLINICAL PICTURE OF A LARGE SIMPLE CYST OF RIGHT BREAST. Note bulging of nipple. Cyst fluctuated. Halsted's clinic.

fact is good evidence in favor of a simple cyst. The majority of cases suffering with this disease seek advice within six months. Pain is often the symptom of onset, and in the rapidly forming cyst pain and tenderness are present. At the examination a slight discharge from the nipple may be found.

This disease, when observed in younger women, with rare exceptions, has its

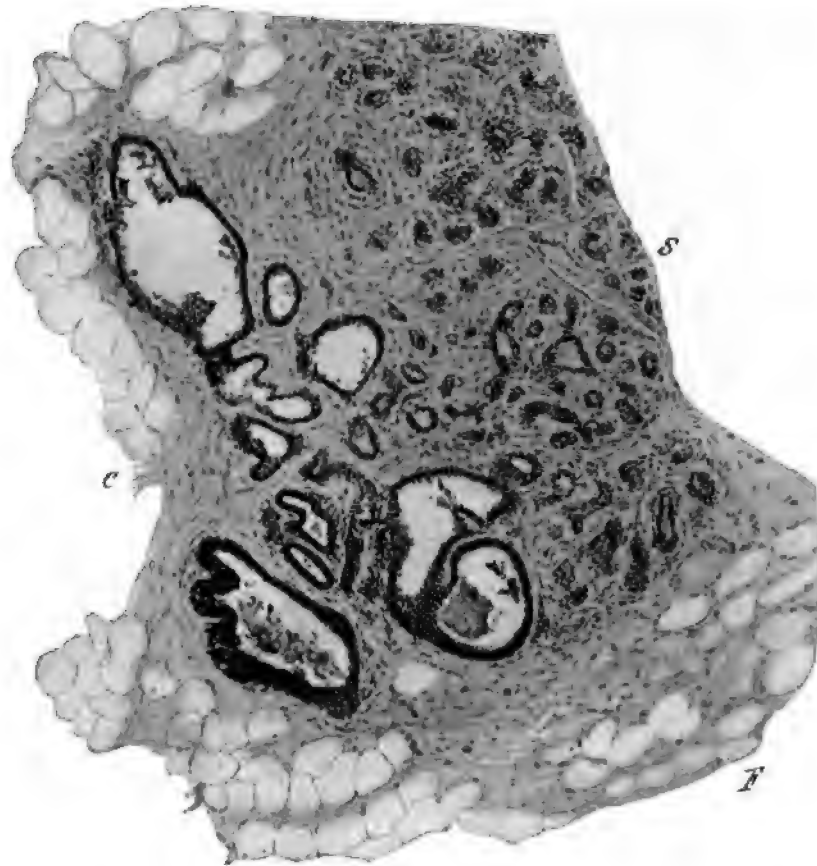


FIG. 457.—SENILE BREAST (S); FAT (F); ECTASIA AND MINUTE CYST FORMATION (C).
Microscopic drawing of area of breast containing multiple, large, simple cysts; one tumor of ten years' duration (Neilson-Ford).

onset in a breast which never lactated. (One exception, æt. thirty-five, last lactation two years.)

When there has been a history of lactation, with the above exception, the women have all been older than forty, and the time since the last lactation six years or more.

Clinical Picture of Multiple Tumors.—When this hypertrophy of the adenocystic type involves a distinct quadrant or hemisphere, in a few cases, smaller palpable areas in the opposite breast allow an almost positive diagnosis, and in such instances I have removed both breasts.

When there are two or more circumscribed tumors in one or both breasts the

diagnosis of multiple simple cyst is not difficult. When there is one large circumscribed tumor, other multiple small, shot-like tumors, in the same or opposite breast, may be looked upon as good evidence of the cystic type of this disease.

The cases exhibiting the clinical picture of a small area of induration have been single lesions, and palpation of the remaining breast tissue was negative.

Gross Pathology and Treatment.—At the exploratory incision it is not difficult to recognize the simple cyst (Fig. 448). There is a distinct fibrous wall a few millimeters in thickness. This has a smooth inner surface. Here and there there may be brownish pigmented areas on the surface. In a few cases the wall may be thicker (Fig. 458). The contents of the cyst is never hemorrhagic, thick, or granular. (Blood in a cyst without a papilloma indicates carcinoma. Cysts with very thick granular contents have always been malignant.)

When one explores the small area of induration and opens one or two small cysts surrounded by fibrous breast tissue, this finding indicates a benign lesion. I do not believe it should be mistaken for carcinoma.

The appearance of the adenocystic type of this hypertrophy is so characteristic that it should not be mistaken (Plate I, Fig. 2). It differs from the cystic adenoma (Plate II, Fig. 2; p. 220) only in the fact that it is not encapsulated. One sees numerous cysts filled with granular contents.

Having exposed the adenocystic type of this hypertrophy, one should at once search for carcinoma. A malignant infiltration is indicated by increase of the fibrous tissue (Plate I, Fig. 2 [x]) and diminution in the size of the cyst, with the appearance of granular areas without cyst walls, which can be expressed.

If a simple cyst is found and the breast is normal (Fig. 459), excision of the cyst is sufficient. If the breast shows the early adenomatous stage of the hypertrophy (Fig. 448), excision of the cyst only is justifiable. When the cyst is large and the remainder of the breast practically senile (Figs. 457 and 458), remove the breast. When the entire breast is riddled with other cysts and dilated ducts (Fig. 449), remove the breast.

In my experience, the fully developed adenocystic stage (Plate I, Fig. 2; and Fig. 454) has rarely been present with large simple cysts (Fig. 449); however, if this condition of the breast were exposed on exploring the simple cyst, the entire breast should be removed after a thorough search for carcinoma.

Among the fourteen cases of carcinoma arising in the adenocystic type of senile parenchymatous hypertrophy none has shown large simple cysts

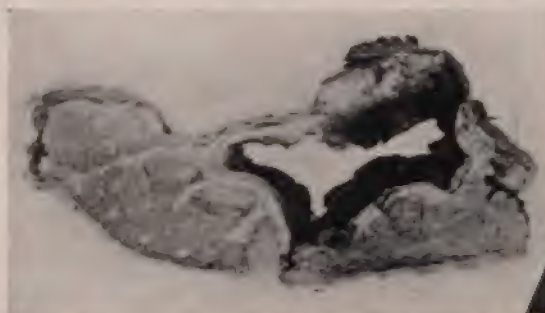


FIG. 458.—SECTION OF ALCOHOL SPECIMEN FROM BREAST IN FIG. 456.

Showing thick-walled, simple cyst surrounded by fatty, senile breast. Photograph by Murray.

Any evidence of carcinoma at the exploratory incision in this disease should indicate a complete operation, and I would advise such an operation in cases of doubt.

If a patient is observed before or during the menopause with multiple areas in one or both breasts, of increased consistency, but no definite tumor, and associated with slight pain, I believe that this can be looked upon as the early stage of this hypertrophy, and operation need not be advised until there is a definite growth in one or more areas. However, such patients should be carefully watched.

MASTITIS.

Mastitis may be divided into pyogenic, tubercular, and syphilitic. Other

etiologic factors, for example, actinomycotic, are so rare that they need not be considered.

Pyogenic mastitis may be acute or chronic and may take place with or without abscess formation (11.7 per cent. of benign lesions).

Tubercular mastitis is chronic and always leads to an abscess formation (6 per cent.).

Syphilitic mastitis without the formation of gumma is such an unusual condition that it may be excluded, even gumma formations being uncommon.

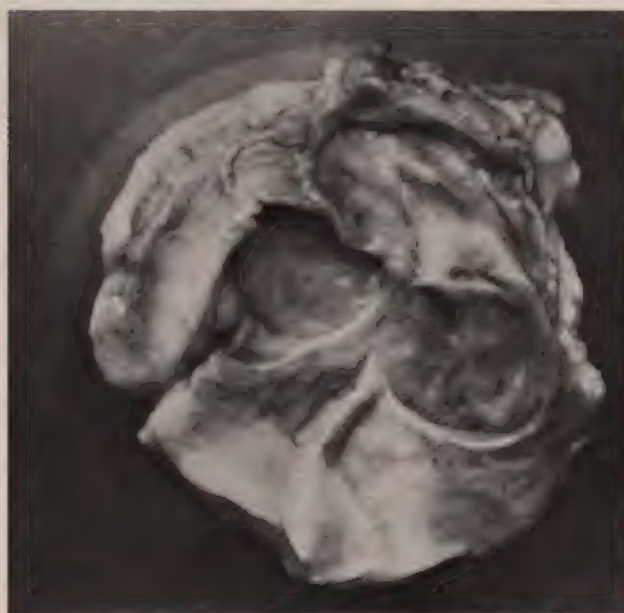


FIG. 459.—SIMPLE CYST IN NORMAL BREAST.
Photograph from fresh specimen (Schapiro).

Pyogenic mastitis not associated with lactation is a very unusual occurrence.

Mastitis begins as an area of induration and, in the majority of cases, should exhibit quickly the clinical picture of an abscess or a gumma. If there is no history of lactation, the abscess is probably of tubercular origin.

An abscess or gumma can easily be distinguished from a malignant tumor at the exploratory incision. Suppuration in a malignant tumor of the breast rarely takes place before the tumor has assumed the positive clinical picture of malignancy. I have seen suppuration in small circumscribed malignant tumors on but two occasions; both had been treated for abscesses, but if the tumors had been carefully studied, the definite signs of carcinoma would have been recognized.

An area of induration in the lactating or non-lactating breast, which persists and does not assume the clinical picture of an abscess, should always be regarded as

suspicious, and explored. It will usually be found to be carcinoma. Chronic mastitis is possible, but very rare. A chronic non-tubercular abscess is possible, but unique; it may be confused with the early stage of a gumma or tuberculosis.

Lactation Mastitis.—The gross and microscopic pathology of lactation hypertrophy has been given (Figs. 435 and 436). The vessels and lymphatics of the breast are present in the intralobular stroma about the ducts and acini. The portal of entrance for the infection is usually from the nipple; it is possible from the blood, axilla, chest, and neighboring skin, due to the ramification and anastomoses of the lymphatics of the breast.

Indurations of the breast due to mastitis are practically never observed in the pregnant period. The so-called caked breast observed during the first few days after



FIG. 460.—SINUS FORMATION IN CHRONIC PYOGENIC MASTITIS.
Photograph of excised breast; sinuses about nipple (Schapiro).

labor quickly disappears. So rarely does the early caking lead to abscess formation that we may look upon it in the majority of instances as due to the accumulation of milk secretion and to congestion of the vascular breast tissue.

Pyogenic mastitis is usually acute, and is observed chiefly before the fourth month of lactation. The area of induration may be single or multiple, in one or both breasts. It is frequently associated with some break in the epidermis of the nipple. The general symptoms are fever and leukocytosis.

Fever in the first days after labor is usually due to an infection through the uterus; later the breast must be examined for the source of the infection. The area of induration of lactation mastitis is tender, and over it there may be slight redness of the skin. Resolution is possible without pus formation at this stage. The clinical

signs of abscess are redness and edema of the skin, fixation of the skin to the indurated mass, boggy or fluctuation of the mass.

If the abscess is not properly incised, it may rupture spontaneously through the skin and heal. Spontaneous cures of abscess are rare. The abscesses may be multiple in one breast, rupture, leaving a breast with numerous sinuses, indurated, and with a retracted nipple (Fig. 460). Healing of the sinuses may take place.

Lactation mastitis without acute symptoms is possible, but less frequent than the acute. There may be simply an area of induration, with or without fever. This area may be slightly tender, and should disappear after a time. This is the chronic form without abscess formation. On the other hand, the area may gradually increase in size until it involves a quadrant or a hemisphere, and gives rise to the clinical picture of a tumor (Fig. 461)—a chronic mastitis abscess.

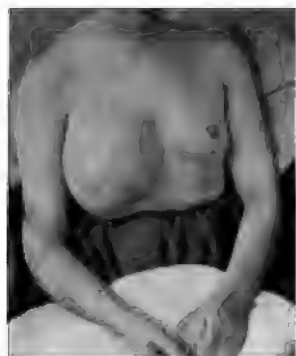


FIG. 461.—CHRONIC PYOGENIC LACTATION MASTITIS, ABSCESS.

Age, twenty-four; onset of tumor, two months, in second month of lactation; mistaken for cancer cyst. Halsted's clinic.

Multiple minute abscesses of the breast due to chronic mastitis during lactation have been observed.

The area of induration of a lactation mastitis, with or without abscess, may persist unchanged for months or years. In my experience carcinoma usually develops in such an area.

Diagnosis and Treatment.—In the diagnosis one is anxious to recognize the lesion the moment pus formation has taken place, and to follow this by an incision for drainage. On the other hand, in the more chronic cases one must always bear in mind the possibility of carcinoma. An area of induration in the lactating breast if due to pyogenic mastitis should disappear, or exhibit symptoms of an abscess very quickly. The latter demands immediate incision; the former, after a delay of a few weeks, exploration.

In exploring an induration of the lactating breast the following lesions are possible: a galactoceles (p. 196); a benign tumor (p. 212); tubercular mastitis (p. 211); a cancer cyst (p. 246); a solid carcinoma (p. 240), or a pyogenic mastitis. The gross appearance of the former will be described, and should be differentiated from mastitis.

In pyogenic mastitis the knife will pass through lactating breast from which milk can be expressed; then a zone of condensed breast tissue slightly hemorrhagic, from which milk cannot be expressed; then a distinct abscess wall lined by granulation tissue, after which purulent material is encountered.

In the chronic abscess the wall is thicker, the granulation tissue lining more distinct, and the pus thinner.

In a few cases there is not a single abscess, but multiple minute abscesses. I have never observed the latter in a malignant tumor of a lactating breast.

Incision and drainage are sufficient for the single acute abscess. In the chronic abscess the wall should be excised.

In the chronic condition with multiple abscesses or sinuses the breast will have to be removed.

In the acute abscess, before incision, passive hyperemia after the method of Bier, with a glass jar, should be tried as a method of treatment. Bier claims that resolution more frequently follows such treatment. When the incision is made, it can be small, and to the opening a vacuum cup of Bier should be applied two or three times a day. There is no space to discuss Bier's treatment of infections, but there is no doubt in my mind that this method has a distinct place in the treatment of pyogenic infections of the breast, and perhaps tubercular.

My colleague, Williams, agrees with me that massage is contraindicated during lactation. It is of no value for caked breast or mastitis, and would be very harmful if the area of induration were due to carcinoma.

The usual treatment employed to check the secretion of milk when, for various reasons, the infant is not to nurse the breast, is, according to Williams, entirely unnecessary. The secretion of milk will cease if the child is simply removed. The patient may need one or two small doses of morphin. Pumping, massage, ointments, and bandaging simply increase discomfort.

Mastitis of the Non-lactating Breast.—

The clinical picture, diagnosis, and treatment do not differ from the same pyogenic lesion in the lactating breast. This form of mastitis is rare. It may be due to a pyogenic osteomyelitis of a rib (Fig. 462), traumatism, or it may be secondary to infections in the axilla, arm, chest, or neighboring skin. It has been observed now and then during typhoid fever and in other infectious diseases. Resolution may take place. Abscess is the usual result.

An area of induration due to chronic mastitis in a non-lactating breast may be considered unique. I have seen two cases: one due to an encysted sequestrum, in which the osteomyelitis of the rib produced no clinical symptoms; the other followed a subcutaneous injection of normal salt solution.

Senile parenchymatous hypertrophy (p. 200) has been called chronic cystic mastitis, but as the etiologic factor is not known, I have preferred to discuss it among hypertrophies rather than inflammations.

Tubercular Mastitis (6 per cent. of benign lesions).—Tuberculosis of the breast has been observed to begin between the ages of twenty-five and thirty-five; never before puberty hypertrophy, and a little more frequently in the non-lactating breast. It has been observed during the early months of lactation, and must then be distinguished from pyogenic mastitis.



FIG. 462.—CHRONIC MASTITIS ABSCESS FROM
OSTEOMYELITIS OF RIB.
Halsted's clinic.

It occurs more frequently after the fourth month of lactation, like carcinoma. There may be no family history of tuberculosis and no evidence of tuberculosis elsewhere in the patient. As a rule, but one breast is involved, and in this breast but one focus.

The symptom of onset is a single area of induration, usually in the nipple zone, rarely in the periphery of the breast. Signs of abscess develop quickly without acute symptoms, and spontaneous rupture with sinus formation is observed in the majority of cases before the ninth month.

Not until the abscess or sinus has formed can tuberculosis be diagnosed clinically. At the exploratory incision the granulation tissue lining a tubercular abscess (Fig. 463) has a sufficiently characteristic appearance to allow a positive diagnosis. In

the early stage before abscess formation one undoubtedly would be able to make out caseation. Tuberculin may be used for diagnosis in doubtful cases.

Up to the present time complete excision of the breast has been the routine treatment in tuberculosis. However, if the focus is seen early I am of the opinion that local excision with the preservation of the breast should be done if possible.

Syphilitic Mastitis and Gumma.—Excluding primary lesions of the nipple and areola and secondary manifestations in the skin over the breast, true syphilis of the breast tissue must be rare. I have no observations, nor had Billroth or Gross. Billroth was skeptical of many of the

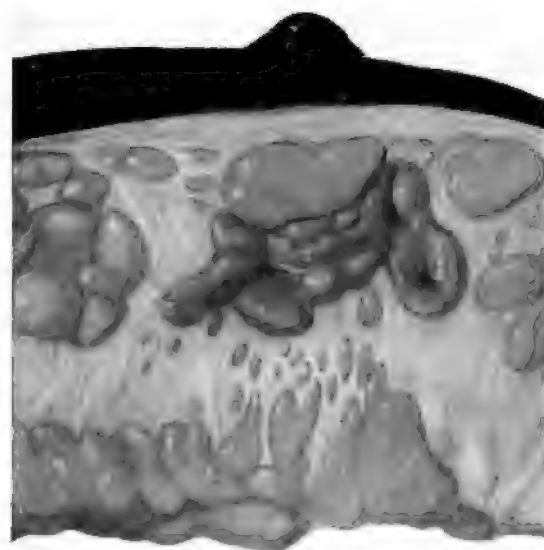


FIG. 463.—CIRCUMSCRIBED TUBERCULAR ABSCESS SURROUNDED BY FIBROUS BREAST.

Colored woman, aged thirty-five; induration three months; spontaneous rupture with sinus formation three weeks. Halsted's clinic.

cases recorded in the literature. Williams describes a diffuse, syphilitic mastitis and a circumscribed gumma, both in acquired and hereditary syphilis. Sheild adds a few cases. These two authorities state that the patients had other manifestations of lues, with few exceptions.

In view of the rarity of syphilitic mastitis I do not believe such a diagnosis should be made, even with manifestations of syphilis elsewhere, until the lesion has been explored.

BENIGN TUMORS.

The non-indigenous benign connective-tissue tumors rarely develop in the breast tissue.

Lipoma may be single or multiple. The large tumors may reach a great size (Fig. 464), and should not be difficult to differentiate from the large intracanalicular myxoma. A smaller lipoma buried in the breast tissue would only be recognized at the exploratory incision. I have observed but three cases: two were multiple small tumors, one a large tumor. The literature has recently been collected by Delage and Massabiau.¹

Fibroma.—I have never observed this tumor in the breast. This agrees with the observations of Billroth and Schimmelbusch. Williams claims to have seen pure fibroma. In the older adenofibroma it is possible for the parenchyma to undergo complete atrophy.

Areas of Calcification.—I have seen calcification in an adenofibroma of many years' duration in the breast of an adult woman. Definite crepitus was elicited and the diagnosis made. There was a carcinoma in the other breast. Billroth observed calcified areas in the wall of simple cysts, in adenofibroma and scirrhous carcinoma. Williams records calcification in a sarcoma. I have never observed calcification in malignant tumors. Thayer² records a case of diffuse calcification in the breast and axillary glands after an incision of a post-typhoid mastitis abscess. Thayer looks upon the calcification as due to the reaction between the calcium in the subcutaneous infusion given into this breast because of a hemorrhage, and the iodin and the iodoform gauze used for drainage.

Enchondroma and Osteoma.—Billroth found but one case of an enchondroma, which also contained some bone tissue. Williams and Sheild record a few cases. I have never observed an example of these tumors and find nothing in recent literature. Areas of cartilage without bone formation have been observed in the breast of female dogs. I have observed cartilage in the so-called mixed tumor of the breast, which is nothing more than an intracanalicular myxoma with islands of cartilage, and this tumor usually has become a sarcoma.

Angioma.—Skin and subcutaneous angioma might involve the breast. Billroth was of the opinion that all angiomata of the breast were of this origin. Sheild and Williams record a few cases of angioma without connection with the skin or subcutaneous fat. We know that primary angioma of muscle is possible; it has been observed in the parotid gland and other organs; why not in the breast? I have observed one fibro-angioma which clinically was compressible, very vascular on section, and under the microscope contained so much vascular tissue in the stroma between the parenchyma that I looked upon the tumor as an example of a mixed angiofibroadenoma.



FIG. 464.—HUGE LIPOMA OF BREAST (from Billroth).

¹Delage and Massabiau: *Révue de Chir.*, xxv, No. 10.

²Thayer: *Johns Hopkins Hosp. Bull.*, Feb., 1906.

The recognition and treatment of angioma of the breast should not be difficult. It cannot be mistaken for the angiosarcoma and the hemorrhagic carcinoma which I will describe later.

Hydatid Cysts.—LeConte¹ reports an observation of his own and gives the literature.

The diagnosis must rest upon the demonstration of the hooklets. Clinically, the picture is that of a chronic pyogenic abscess, of a doubtful tumor. The cyst usually contains purulent material.

Encysted Foreign Bodies.—The example of an encysted sequestrum from a rib has been recorded (p. 211). Clinically, it presented itself as a small area of induration. The diagnosis was not made until the exploratory incision. In one case of carcinoma of the breast I found the parasite of trichinosis encysted in the breast and pectoral muscle.

Dermoid Cysts.—These tumors are rare; they may be in the skin or buried in the breast tissue. The benign cyst never assumes the clinical picture of a malignant tumor. If infected, it may resemble an abscess. The dermoid is recognized at the exploratory incision by its distinct cyst wall, easily separable from the surrounding tissues, and by its characteristic contents.

The dermoid may become malignant. Usually this change is associated with involvement of the skin which allows a clinical diagnosis (this was so in my one observation). If not, the wall of the malignant dermoid cyst is thick, fixed to the surrounding tissue, and on section has the typical appearance of cancer.

FIBRO-EPITHELIAL TUMORS.

Among 333 benign tumors of the breast 39 per cent. were of the fibro-epithelial type: 27 per cent. intracanalicular myxomata, and 12 per cent. adenofibromata.

Intracanalicular Myxoma.—This most common tumor of the young female breast is due to a hypertrophy of the periductal or intralobular stroma which develops during puberty hypertrophy.

Clinically, the tumor may be single or multiple, in one or both breasts, of small size, or it may appear as a large tumor, involving part, half of, or the entire breast.

Multiple Tumors.—In about 20 per cent. of cases the tumors have been multiple, in one or both breasts. In the majority the age of onset has been less than twenty-five years; in a few the multiple tumors had not been observed by the patient until after twenty-five, up to forty years. The clinical picture and the fresh appearance of one of the multiple tumors does not differ from that of the single tumor.

When the patient is under thirty the clinical diagnosis is not difficult, and, in my experience, operation is not indicated unless one of the tumors is the seat of pain or growth. The tumor should be removed.

So far, in my observation, it has never been necessary to sacrifice the breast. I have observed some of these cases fifteen years. The small multiple tumors have given no further trouble. In some the breasts have lactated, and the tumors have

¹LeConte: Amer. Jour. of Med. Sciences, Sept., 1901, cxii, 277.

not given any discomfort. I have noted before that if such a tumor is removed during lactation its parenchyma shows the characteristic hypertrophy of the physiologic process present in the breast tissue.

When the patient is over thirty, it would be difficult to differentiate multiple intracanalicular myxomata from multiple cysts. In both cases, however, whether the tumors are giving pain or exhibiting growth or not, at least one should be explored and removed for diagnosis.

Up to the present time I have never observed either a carcinoma or a sarcoma in a breast which was the seat of multiple intracanalicular myxoma. For this reason, in the relatively very few cases in which the multiple intracanalicular myxoma is observed in the breast of women over twenty-five complete removal of the breast is not necessary to insure the patient against cancer or sarcoma.

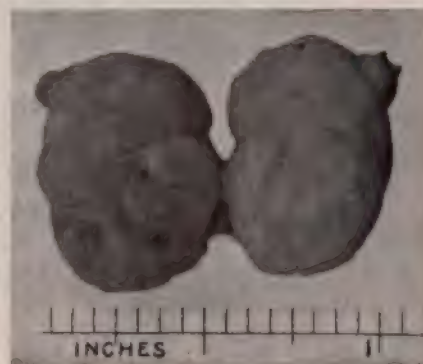


FIG. 465.—SMALL ENCAPSULATED INTRACANALICULAR MYOMA.

Photograph of fresh specimen by Schapiro.



FIG. 466.—MEDIUM-SIZED INTRACANALICULAR MYXOMA, WITH CHARACTERISTIC SMALL AND LARGE LOBULATIONS.

Female, aged thirty, tumor two years. Photograph from painting of specimen.

Small Single Tumors.—In at least 70 per cent. the intracanalicular myxoma has appeared as a small single tumor. The age of onset has varied between fifteen and twenty-five years. Between twenty-five and forty-three I have observed a few scattered cases. The tumor is freely movable, and, when it can be palpated, distinctly encapsulated; the majority have a characteristic lobulation and elasticity. In a few instances the tumors have been smooth and tense, resembling an adenofibroma or a cyst. Growth, as a rule, is slow. The duration of the tumor has varied from a few weeks to ten years.

Pathology.—At the exploratory incision the tumor has a distinct capsule (Plate II, Fig. 1; and Fig. 465) and is usually lobulated (Fig. 466). The cut surface exhibits roundish, bulging, myxomatous lobules of from 1 to 3 mm. in diameter. The microscopic appearance (Fig. 467) is sufficiently characteristic to recognize easily in the frozen section.

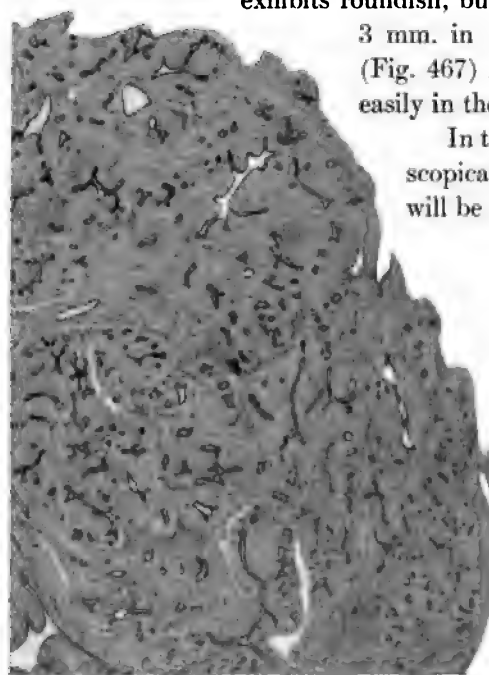


FIG. 467.—INTRACANALICULAR MYXOMA.
Low-power microscopic drawing by Horn.

In the younger tumor one will observe, microscopically, more parenchyma; the epithelial cells will be of a higher type, and exhibit proliferation, degeneration, desquamation. Given a very small young tumor in the female breast, it will be difficult to differentiate macroscopically and microscopically the cystic adenoma, the adenofibroma, and the intracanalicular myxoma. A differential diagnosis is, of course, of no practical importance. As the tumors grow larger and become older the distinctly gross and microscopic features of the type become evident.

Treatment.—I am of the opinion that these single tumors should be removed. In the younger women removal of such a tumor insures the

patient against the complete removal of the breast should this tumor be allowed to grow to great size; and against the possibility of sarcoma, which usually takes place when the intracanalicular myxoma has reached a large size. In the older woman the operation is imperative, because a positive clinical diagnosis cannot be made. Excision of the tumor, if it is encapsulated and has the characteristic appearance of a benign neoplasm, is sufficient; but if the tumor looks very cellular, it should be treated as a sarcoma (see p. 249).

Up to the present time, in about ten single, small, intracanalicular myxomata observed in the breast of women between thirty and forty-three one has been a sarcoma, cured by the complete operation.

The Single Large Tumor.—In about 10 per cent. of cases the intracanalicular myxoma has involved half or the entire breast (Fig. 468). With few exceptions the age of onset has been over thirty; the oldest, fifty-two. The duration of the tumor varied from one to four years.

To illustrate my point that a single small tumor in the breast of a young woman should always be removed, I quote the following example: A woman of twenty observed a small tumor in the right breast; it required ten years for this tumor to involve the entire breast. An early operation would have prevented mutilation.

As the intracanalicular myxoma grows larger its clinical diagnosis is easier, the lobulation and elasticity become more distinct, and, in spite of the size, the skin and nipple remain normal. In my experience there should be no difficulty in differentiating the large intracanalicular myxoma from the medullary carcinoma. The latter would never reach such a size without involvement of the skin.

Treatment.—In view of the tendency of the large tumor to become a sarcoma one should pay no attention to its pathology, but be governed by the clinical picture. Remove the breast, an area of skin, and the major pectoral muscle (see p. 274).

Pathology.—As the intracanalicular myxoma becomes larger and older one of two definite changes may take place: one entirely benign, the other malignant. The benign change manifests itself by the great increase of the fibrous trabeculae marking the lobules, by myxomatous degeneration up to the development of cysts, and by the atrophy of the epithelial parts of the tumors. The malignant changes take place in the myxomatous tissue; the gross lobulation is lost, the tissue becomes firmer and more cellular.

The largest tumors of the breast belong to the intracanalicular-myxomatous type. The huge tumors found illustrated in the older monographs by Velpeau, Brodie, Billroth, and Gross are of this character, and were called serocystic sarcomata.

Recurrent Intracanalicular Myxoma.—In a few instances, when a single tumor has been removed, later one or more tumors of the same character may develop in the remaining breast tissue. I should look upon such an observation as an example of multiple tumors developing at different periods, rather than a recurrence. Theoretically, this should happen frequently; practically, I have seen it on but two occasions.

Spontaneous Disappearance of Intracanalicular Myxoma.—In view of the comparative frequency of this tumor in the breast of young women and its rarity in older women, and, so far as my observations go, its absence in the breast which is the seat



FIG. 468.—LARGE INTRACANALICULAR MYXOMA, RIGHT BREAST, SIMULATING UNILATERAL HYPERTROPHY.

of carcinoma, we may be justified in concluding that a small intracanalicular myxoma may disappear.

I have never observed a carcinoma to develop in an intracanalicular myxoma.



FIG. 469.—FIBROADENOMA, ACCESSORY BREAST TISSUE.

Photograph from Halsted's clinic (by Wright). The tumor is clasped by the fingers of the nurse; breast to the medial and lower side. (Clinical picture like unilateral hypertrophy.) Girl, aged nineteen, tumor nine months.

Adenofibroma.—Clinically, like the intracanalicular myxoma, we observe the adenofibroma as a single or multiple small tumor, or as a single larger tumor. The age of onset is the same, and in infrequency this tumor, either single or multiple, in women over twenty-five, resembles the intracanalicular myxoma.

The single small tumor is rarely lobulated, may be spherical, is quite hard in consistency, and is usually associated with pain and tenderness. It may be of rapid growth. In quite a few cases the tumors have remained quiescent for years. The older the tumor, the more fibrous. Some may become calcified. I am quite confident that in a few cases of carcinoma with a history of a quiescent, small tumor

of from ten to thirty years' duration, first observed when the patients were under thirty, the original tumor was an adenofibroma or a cystic adenoma.



FIG. 470.—FIBROADENOMA.

Sketch of external appearance after removal from center of breast. Girl, aged sixteen, tumor six weeks. Clinical picture that of unilateral hypertrophy.

It is these observations which emphasize the importance of removing every

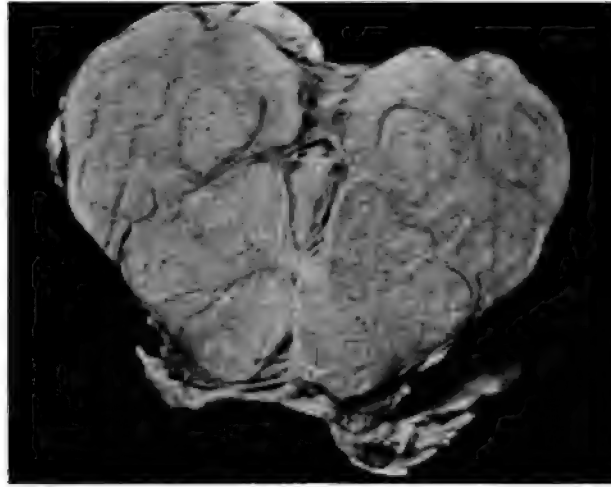


FIG. 471.—FIBROADENOMA, ACCESSORY BREAST TISSUE.
Gross appearance of section of alcohol specimen. See also Plate I, Fig 1.

single tumor of the breast, irrespective of the age of the patient or the duration of the tumor. I have also one observation of a diffuse carcinoma in a breast the seat of multiple adenofibroma of long duration.

The adenofibroma never reaches the size of the larger intracanalicular myxoma, and, so far, has never been observed in older women. The larger tumors, when situated in the center of the breast (Fig. 470) or outside of the breast (Fig. 469) (accessory breast tumors), may give the picture of a unilateral hypertrophy. If such tumors are carefully studied at the exploratory incision, the breast may be preserved. In three of the cases sent to my laboratory the entire breast had been unnecessarily removed.

Pathology.—When the smaller tumor is found in the breast of an older woman, its hardness may suggest a carcinoma, and when explored, it may resemble a carcinoma to the inexperienced eye. A rapid frozen

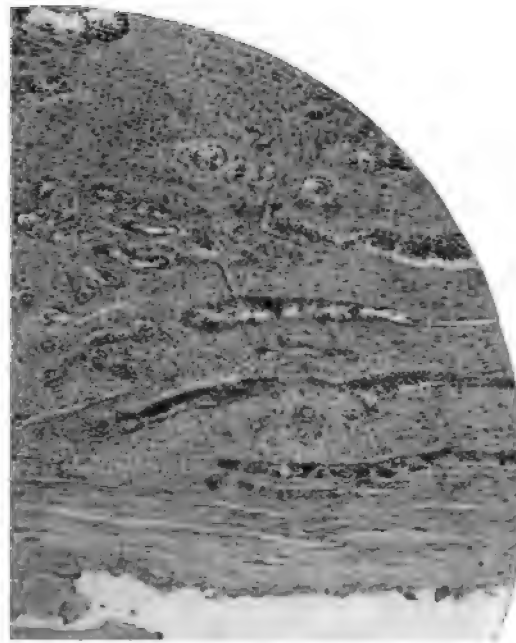


FIG. 472.—FIBROADENOMA.
Microscopic drawing, L. Neilson-Ford. Fibrous tissue in excess; parenchyma undergoing atrophy.

section of an adenofibroma may resemble at first sight a carcinoma, especially if the tumor is fibrous and the parenchyma undergoing pressure atrophy.

This tumor always has a distinct capsule, which is absent in carcinoma. The appearance of the freshly cut surface in the older fibrous tumors shows splits and crevices without epithelial debris (Fig. 471). In the younger and in the larger tumors the pink elevated dots of parenchyma (Plate I, Fig. 1) are distinctive features. Microscopically the older tumor (Fig. 472) is characterized by excessive fibrous stroma, and the parenchyma with the epithelial cells of a low type is undergoing pressure atrophy. In the younger tumors and in the larger tumors of accessory breast tissue the parenchyma predominates, resembling the picture of puberty hypertrophy, but not showing the normal architecture of the breast lobule (Fig. 473).

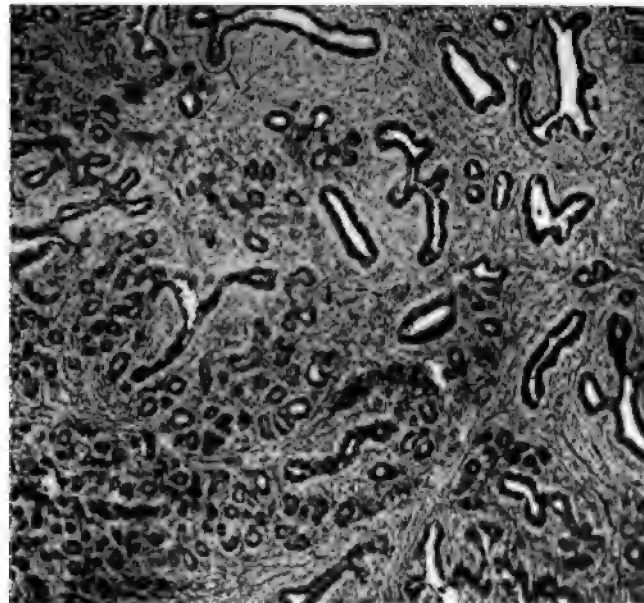


FIG. 473.—ADENOFIBROMA.

Photomicrograph by Wright. Young tumor, parenchyma in excess.

On two occasions I have found adenofibroma and intracanalicular myxoma in the same breast.

BENIGN EPITHELIAL TUMORS.

Cystic Adenoma.—I have observed but five cases (1.5 per cent.). The age of onset varied from twenty-eight to fifty years, the duration of the encapsulated tumor from three months to five years, in breasts which had never been the seat of lactation hypertrophy. All were small, freely movable, encapsulated tumors. At the exploratory incision they could be recognized by the little cystic bulging from the capsule (Plate II, Fig. 2) and by the minute cysts on section. The stroma is scanty.

Microscopically the picture resembles senile parenchymatous hypertrophy; there

PLATE II.



FIG. 1.—SMALL INTRACANALICULAR MYXOMA.
Girl aged eighteen, tumor eleven months. (Halsted's clinic.)



FIG. 2.—ENCAPSULATED CYSTIC ADENOMA.
Sketch from fresh tumor. Female aged twenty-six, tumor ten years. Excision of tumor. Well six years.
(Halsted's clinic.)



are adenomatous areas (Fig. 450), areas of ectasia (Fig. 451), minute epithelium-lined cysts (Fig. 453), and adenocystic areas (Fig. 454).

The differential diagnosis of the benign cystic adenoma from the malignant adenocarcinoma, at the exploratory incision, will be discussed later (page 227).

Twice, in breasts removed for carcinoma, I have observed multiple cystic adenomata (Fig. 474)—unilateral in one case, bilateral in the other. The patient with the unilateral lesion has shown no evidence of trouble in the remaining breast during an observation of six and a half years since operation. The patient with the bilateral lesion, who refused the removal of the remaining breast, died of carcinoma of this breast five and a half years after the first operation.

Cysts with Intracystic Papillomatous Growths.—The interesting fact in the clinical history of this benign cyst is the discharge of blood from the nipple, which is rarely absent, either in the history or at the examination. There are eighteen observations (5 per cent.) of the benign form, while during the same period I have records of fourteen cases in which the papilloma had become an adenocarcinoma (p. 231).

The possibility of a malignant transformation must always be borne in mind. The age of onset is about the same in both the benign and malignant form, from twenty-seven to sixty-four years of age. In the benign cysts the tumor had been present from five to fifteen years, while the longest duration of the tumor in the malignant cyst was twenty years. The duration of the tumor, therefore, will not aid in the differential diagnosis. In both there may be a history of a small tumor which has remained quiescent for a number of months or years, and then taken on rapid growth.

As long, therefore, as the tumor has not developed any clinical signs of malignancy, the diagnosis must be made at the exploratory incision. In the benign cysts the wall does not differ from that of a simple cyst (p. 207), the contents are either hemorrhagic (Fig. 475), cloudy, or clear, never thick and granular. On opening the cyst and sponging out its contents one can see or feel a papilloma projecting from the wall (Fig. 476). This papilloma varies in size: it may be very small and the cyst large, or it may almost completely fill the cyst. Its surface appearance is lobulated and there will be no infiltration of the breast at the base of the papilloma (Fig. 476).

A malignant cyst may be recognized by its thick, grumous, granular contents,

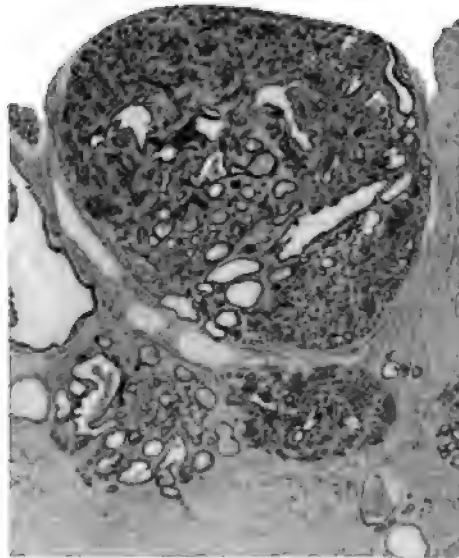


FIG. 474.—CYSTIC ADENOMA.

Low-power microscopic drawing by Horn from one of multiple shot-like tumors in a breast the seat of cancer.

by the changed appearance of the papilloma, or by definite cancer nodules of the cyst wall (p. 231).

In my experience, it is best to remove the entire breast when a benign cyst with a papilloma is exposed, because it is usually situated in the nipple zone, and the nipple must be sacrificed. If there is any doubt as to its malignancy, the complete operation for carcinoma should be performed.

I have observed this papillomatous cyst to be multiple in one case, and similar observations are recorded in literature.

Discharge of Blood from the Nipple.—In both the benign and the malignant papillomatous cyst this has been the symptom of onset in a few cases. In the majority the tumor has been observed within

a year after the discharge was first noticed. In one case the interval was three years; in one patient no tumor could be felt at the examination. The patient came to the clinic because of discharge of blood from the nipple, of five months' duration. The papillomatous cysts were discovered at the exploratory incision.

I have observed three patients with discharge of blood from one nipple which up to the present time have shown no evidence of tumor. In one it is three and a half years since the first symptom; in the others, two years.

If there is nothing but discharge of blood from the nipple, I am of the opinion that such a patient runs no greater risk without operation

than a woman without such a discharge. The probabilities are that a cyst will develop. I presented the choice of an exploratory incision to these three patients, but did not urge it.

CARCINOMA.

It has been sufficiently emphasized that the surgeon should train himself to recognize the malignant epithelial tumors of the breast at the examination. When this is impossible, he should learn to distinguish the benign from the malignant neoplasm at the exploratory incision, or from a rapidly frozen section.

It has been stated before that when a clinical diagnosis of a malignant tumor can



FIG. 475.—CYST WITH INTRACYSTIC PAPILLOMATOUS GROWTH.
Section through breast and cyst showing hemorrhagic contents.
Female, aged fifty-two, tumor ten years.

be made the complete operation should be performed without an exploratory incision. The signs which allow such a diagnosis have been given.



FIG. 476.—SECTION THROUGH BREAST AND CYST SHOWING PAPILLOMA IN FIG. 475.
The breast surrounding the cyst is senile; a few ducts beneath the nipple are dilated.

In the further discussion of carcinoma the gross appearance of the different forms will be described, and this description will be the chief object in view. For purposes

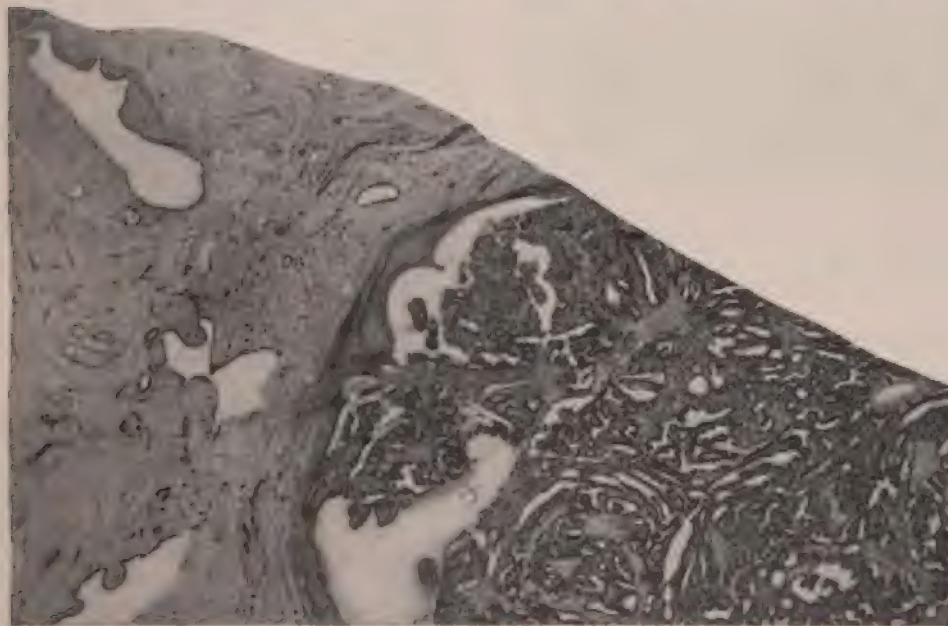


FIG. 477.—MICROSCOPIC DRAWING OF BASE OF PAPILLOMA IN FIG. 476, SHOWING CYST WALL AND BREAST.

of prognosis statistical figures as to the curability of the different forms of carcinoma will be added.

The complete operation for carcinoma should never be restricted, but it is of interest to the surgeon to know the probable result.

Classification of Carcinoma.—For the purpose of diagnosis from the fresh appearance and for the comparative diagnosis, carcinoma of the breast falls naturally into the following groups: adenocarcinoma, medullary carcinoma, scirrhous, and cancer cysts.

Operable and Inoperable Tumors.—In Halsted's clinic of the Johns Hopkins Hospital about 464 patients with primary carcinoma of the breast have been admitted. In 115 (27.5 per cent.) the disease has been inoperable. Among these, partial operations were performed in 72 cases (17.2 per cent.). In every one of these cases there had been undoubtedly an operable period.

This large proportion of inoperable carcinomata of the breast should be reduced by the education of the public and the profession to the fact that every single tumor of the breast should be explored and the indicated operation performed as soon as possible after it is observed by the patient.

The ultimate results in 210 cases which have been followed three years or more since complete operation show that 42 per cent. have remained well three years and more. In this number a few have developed

recurrences after an interval of three years of apparent cure, reducing the percentage to 35 permanently cured at the present time.

When the microscope has failed to find evidence of metastasis to the axillary glands, 85 per cent. remained well three years, and 75 per cent. were permanently cured. This demonstrates that absence of microscopic evidence of metastasis in the removed axillary glands does not exclude the possibility of death within, or after, three years from metastasis.

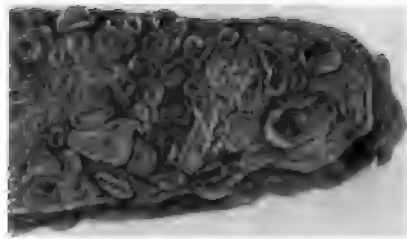


FIG. 478.—COMEDO-ADENOCARCINOMA.
Section of alcohol specimen. (Patient of Geo. A. McCallum, of Canada.)

When the microscope has found metastasis to the axillary glands, the percentage of apparent three years' cure falls to 31, and permanent cures to 24. When the removed supraclavicular glands showed metastasis, the percentage of cures is reduced to 10 and 7 respectively. These figures are given here in order that they may be used for comparison when we study the percentage of inoperable cases and cured cases in the different forms of carcinoma.

Adenocarcinoma.—The relative frequency of this variety is 14.4 per cent. of all cases. The number of inoperable cases is least; the percentage of cures, greatest; the relative number of cases which have been clinically doubtful and in which an exploratory incision has been made, largest.

This gives an opportunity to study the effect of an exploratory incision into a carcinoma. Among ten cases, in which three years or more have passed since the operation, nine are apparently well—90 per cent.; one case remained well four years

and died of internal metastasis later. In this group the percentage of negative microscopic examination of the axillary glands is greatest.

The age of onset in this group is between forty and fifty; in one case the patient was aged twenty-seven, in one thirty-two; the oldest patient was seventy. Adenocarcinoma, therefore, may be met with at any age over twenty-five.

Adenocarcinoma, for the purpose of the description of its fresh appearance, should be divided into the following varieties: the comedo, or duct cancer; the colloid; the adenocystic, and the malignant intracystic papilloma.

Each one of these varieties may be pure, or the tumor may be mixed with scirrhous or medullary carcinoma.

The *adenocarcinoma comedo* begins as a circumscribed tumor. At the exploratory incision there is no capsule. The cut surface shows trabeculae of fibrous tissue in the meshes of which are round, granular areas, from the center of which worm-like comedo-bodies can be expressed (Figs. 478, 479, and 480). The appearance of this tumor is absolutely charac-



FIG. 479.—COMEDO-ADENOCARCINOMA.
Photograph from Kaiserling specimen, showing skin, fat, tumor, muscle (by Schapiro).



FIG. 480.—RECURRENT COMEDO-ADENOCARCINOMA.
Photograph of section through alcohol specimen, showing small fungous tumor, skin, fat, and muscle. See Fig. 484. Photograph by A. S. Murray.

teristic and cannot be mistaken for any benign lesion. Microscopically the round, large alveoli are filled with epithelial cells of the morphology of the basal cell of the duct; the central cells show necrosis (Figs. 481 and 482).

This tumor, in its early stage, is clinically doubtful. In its further growth it infiltrates to the skin and may ulcerate, producing a fungous growth (Figs. 483 and 484). Among twelve cases of the pure type I have yet to observe metastasis to the axilla. All so far have been permanently cured. In one the tumor was bilateral (specimen sent me by McCallum, of Canada). The only positive cure of a recurrent carcinoma belongs to this group. The recurrent tumor was a fungus (Fig. 484).

One of these patients who refused the removal of the other breast died five years later of cancer of this breast. This patient had multiple shot-like tumors (Fig. 474) in both breasts, one of which had taken on recent growth. The growing tumor

The complete operation for carcinoma is of great interest to the surgeon to know the probability of cure.

Classification of Carcinoma.—For the purpose of appearance and for the comparative diagnosis, the tumor is divided into the following groups: adenocarcinoma, cancer cysts.

Operable and Inoperable Tumors.—At the Johns Hopkins Hospital about 464 patients were admitted. In 115 (27.5 per cent.) partial operations were performed. In these cases there had been undoubted

This large proportion of inoperable cases is due to the education of the public and to the fact that the tumor of the breast should be explored as early as possible after it is observed by the patient.

The ultimate results in 210 cases of carcinoma since complete operation shows

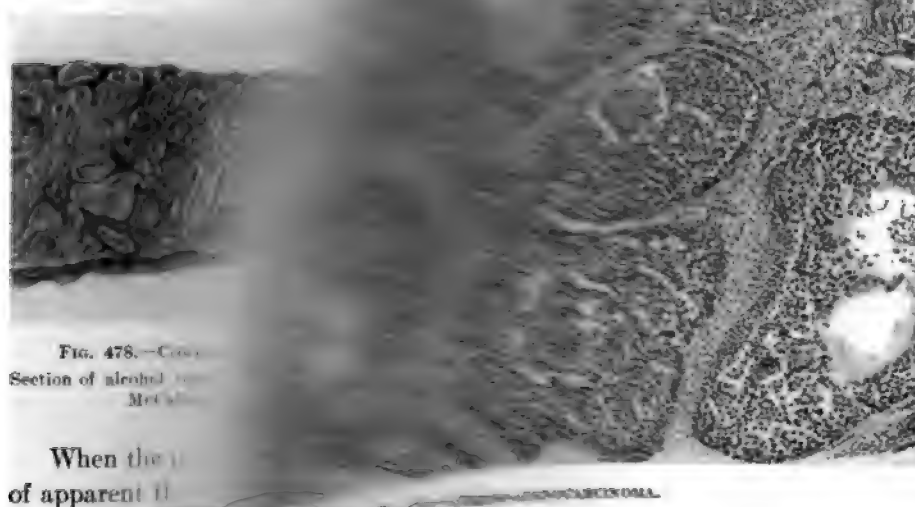


FIG. 478.—Cross-section of alcohol-fixed breast tissue showing carcinoma.

When the tumor is of apparent ill character, the removal should be reduced to the minimum and the breast should be used for the purpose of the cases in the laboratory.

Adenocarcinoma.—In all cases of adenocarcinoma the removal of the tumor should be complete and the probability of a cure conforms to the results of the operation. Among our eight cases all had metastasis in the lymphatic system, but all of these developed late metastases. In the cases of carcinoma, every two and sixty-five, that is, in the breasts

of the breast for this purpose. The cells in the tumor masses in the breast are carcinoma baso-epithelioma (Fig. 485), and the gross from the breast is one with carcinoma. In all patients

In one who had allowed the removal of the tumor to be incomplete, the result was a cure and death. This observation is one of the records in the laboratory, and which is a record of the operation even in this, the least malignant

carcinoma-comedo, with scirrhus or medullary, and the probability of a cure conforms to the results of the operation. Among our eight cases all had metastasis in the lymphatic system, but all of these developed late metastases. In the cases of carcinoma, every two and sixty-five, that is, in the breasts

was an adenocarcinoma-comedo; the others, cystic adenomata. It was for this reason that I advised, after the first operation, the removal of the other breast.

The comedo type is the most common form of adenocarcinoma. The cells in the tumor just described are of the basal type and arranged in solid masses in the long tubules, and, according to Krompecher, would be called *adenocarcinoma basocellulare solidum*. In a few cases the cells have had a special arrangement (Fig. 485), and Krompecher calls this arrangement *adenoides*. It differs in the gross from the *solidum* in the absence of the central necrosis. Among three cases—one with metastasis to the axilla—in which the complete operation was performed, all patients

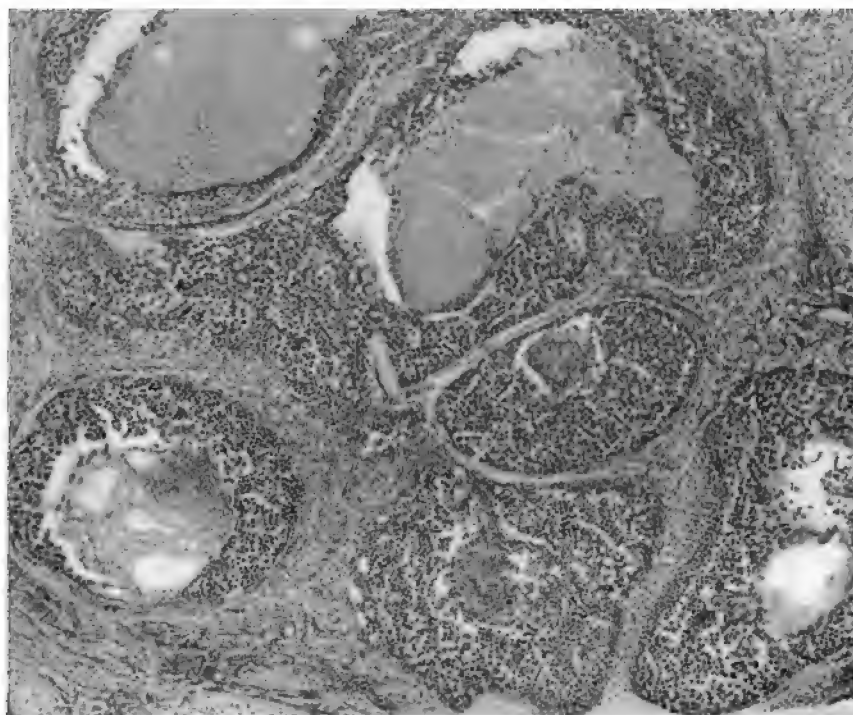


FIG. 481.—COMEDO-ADENOCARCINOMA.
Microscopic drawing by Horn.

have remained well from five to seven years. In one who had allowed the removal of only the breast, there was later recurrence and death. This observation is one among a number of others of which I have records in the laboratory, and which demonstrate the insufficiency of an incomplete operation even in this, the least malignant form of cancer.

The mixed types of this adenocarcinoma-comedo, with scirrhous or medullary, have always been clinically malignant, and the probability of a cure conforms to that in medullary or scirrhous carcinoma. Among our eight cases all had metastasis to the axilla; four were cured three years, but all of these developed late metastases.

The age of onset has been between forty-two and sixty-five, that is, in the breasts

of older women. Although the tumor is apparently a duct cancer, it has never been

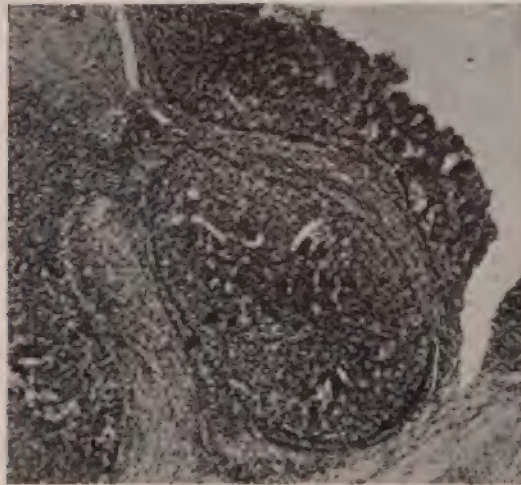


FIG. 482.—COMEDO-ADENOCARCINOMA.
Photomicrograph by Wright. See Fig. 480.

observed in the nipple zone. In the large majority of cases the remainder of the breast is senile. In a few the breast has shown senile parenchymatous hypertrophy, so common at this age; in one patient there were multiple cystic adenomata; in this and one other case the disease was bilateral.



FIG. 483.—COMEDO-ADENOCARCINOMA, BECOMING MEDULLARY CARCINOMA.
Huge fungous tumor. Woman, aged fifty, tumor three years; fungus nine months. Cured three years. Halsted's clinic.

Colloid Adenocarcinoma.—In its onset this is a small, circumscribed, clinically doubtful tumor. At the exploratory incision there is a thin capsule (Fig. 486), and one sees between the narrow, fibrous trabeculae bulging, pink, gelatinous lobules—an appearance which should not be mistaken for any other tumor (Fig. 487).

Three cases have been observed in Halsted's clinic, one a recurrent tumor, all cured by the complete operation. I have tissues from four other cases.



FIG. 484.—RECURRENT ADENOCARCINOMA; FUNGUS TUMOR.

For gross and microscopic picture see Figs. 480 and 482. Photograph by Cushing. Halsted's clinic. Female, aged sixty-five, disease two years; excision of tumor only, eight months after onset; immediate recurrence; complete Halsted operation; no metastasis to axilla. Well ten years.

I feel that the operation should never be restricted in this form of cancer, even in its early, pure state. The study of the recurrent case in the surgical clinic and

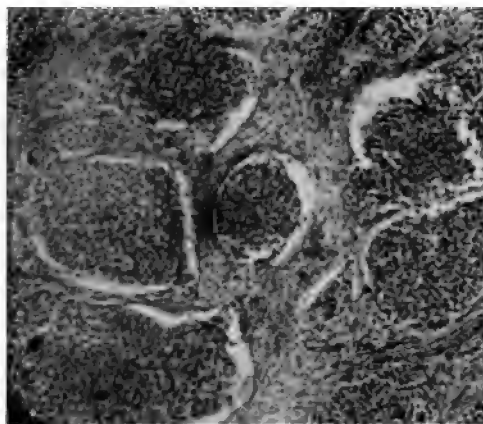


FIG. 485.—COMEDO-ADENOCARCINOMA (ADENOIDS TYPE).
Photomicrograph by Wright.

two outside recurrent cases indicates that the origin may be multicentric, and the recurrences are explained by secondary tumors in the breast left behind.

This tumor may become a scirrhous carcinoma—one observation, not cured.

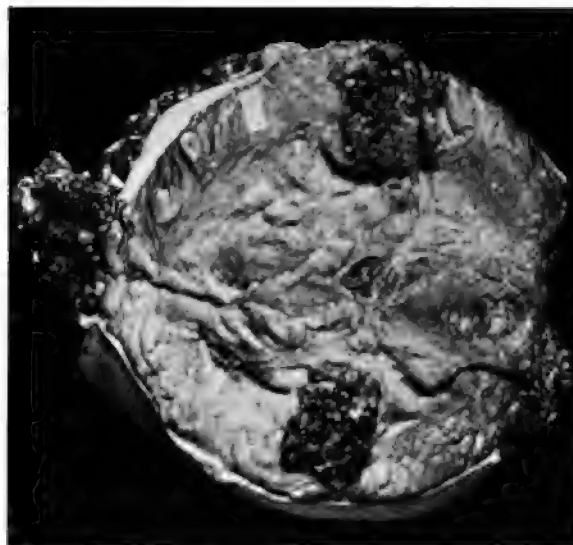


FIG. 486.—COLLOID ADENOCARCINOMA.

Photograph from fresh specimen by Schmitz. Circumscribed tumor in a fairly normal breast. Female, aged forty-three, tumor nine months; clinically malignant; diagnosis based on shortening of skin trabeculae. Complete operation; no metastasis to axilla. Cured four years.

It is a tumor of the senile breast. The age of onset varies between thirty-nine and sixty-nine. It is of slow growth. The clinically benign tumors have been of

less than one year's duration. In one in which there was an ulcer, the tumor of seven years' duration was still circumscribed, and there was no metastasis to the axilla. In one the tumor had been quiescent for seven years, and then took on activity; three years later the skin was adherent and the nipple retracted.

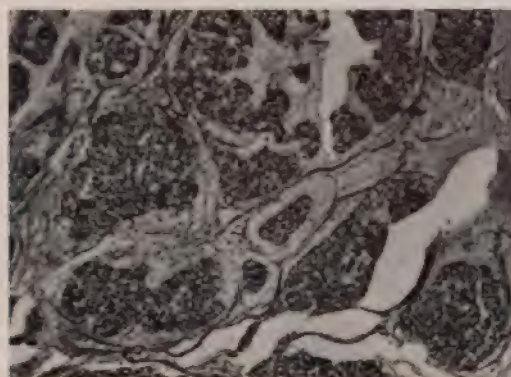


FIG. 487.—COLLOID ADENOCARCINOMA.
Photomicrograph of tumor in Fig. 486 (by Wright).

Cystic Adenocarcinoma.—This form is better described in two groups: the first, a circumscribed tumor, which may be looked upon as a malignant cystic adenoma; the second, the adenocarcinoma arising in senile parenchymatous hypertrophy.

Circumscribed Form.—The malignant cystic adenoma, like its benign prototype



FIG. 488.—ADENOCARCINOMA, ADENOCYSTIC TYPE; CIRCUMSCRIBED TUMOR.
Photograph of alcohol specimen by A. S. Murray. Clinically malignant (adherent skin). No metastasis to axilla. Cured four years.

(Plate II, Fig. 2) is a relatively infrequent tumor. When clinically benign, it can be differentiated from the adenoma by the absence of a capsule; on section, there is more fibrous tissue, very few cysts, but granular areas without cyst walls, which express

on pressure (Fig. 488). Two cases of the pure type (one with metastasis to the axilla) have remained well eleven years since operation. One who allowed only the excision of the breast returned in two years with metastatic axillary glands, and again refused operation—another observation of the danger of incomplete removal

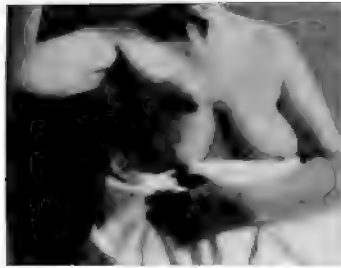


FIG. 489.—ADENOCARCINOMA, ADENOCYSTIC TYPE.

Photograph of patient showing involvement of skin. In this case the tumor infiltrated the pectoral muscle; there was no metastasis to axilla, and the patient has remained well nine years after the complete operation. Halsted's clinic.

of a cancer of the breast. Two cases of this type mixed with scirrhus originated in the lactating breast; neither was cured.

The pure type has appeared in the senile breast. The patients' ages varied from fifty-two to sixty-four at onset. The duration of the tumors has varied from two to ten years. Only the mass of two years' duration was clinically benign. The age of the patients in whom the tumors appeared during lactation was thirty-eight and forty-five; in both the mass had been treated for chronic mastitis for eight months, and *with massage!*

Like the adenocarcinoma-comedo, the circumscribed cystic adenoma may, in its growth, infiltrate skin and muscle (Fig. 489), and yet such an extensive local infiltration is not incompatible

with a permanent cure. It is in this form of carcinoma that more extensive local operations with resection of ribs and intercostal muscles are justifiable.

The Diffuse Form.—I have discussed the recognition of carcinoma in senile parenchymatous hypertrophy (page 201). Four cases in which carcinoma was



FIG. 490.—ADENOCARCINOMA IN SENILE PARENCHYMATOUS HYPERTROPHY.

Showing one cyst with intracystic papillomatous growth. Metastasis to axilla. Photograph from painting by Miss Hayes, from section through breast.

early (one with metastasis to the axilla) have been cured four to fourteen years. In one the breast only was removed (Plate III); this patient has remained well over four years. This is our only example of a carcinoma cured by an incomplete operation. It was interesting to note that two tumors of this type mixed with scirrhus,

PLATE III.



MEDULLARY CARCINOMA. ADENOCYSTIC TYPE.

From painting by Horn, Halsted's clinic. Female aged forty-three, tumor two years; metastasis to axilla.
Cured four years. (Original, Bloodgood.)



both with metastasis to the axilla, have been cured, one not cured (Figs. 490, 491, 492), giving a percentage of 66.

The patients, at the onset of the disease, have varied in age from thirty-six to fifty-five. In the early type the duration of growth varied from two weeks to eight months; in the mixed, from four to eight months.

Palpable masses of durations of more than eight months have not been observed. The evidence, then, is that senile parenchymatous hypertrophy which has reached a stage in which a quadrant of the breast is involved always becomes cancer, and may do so in four weeks, usually within six months. If there is no metastasis to the

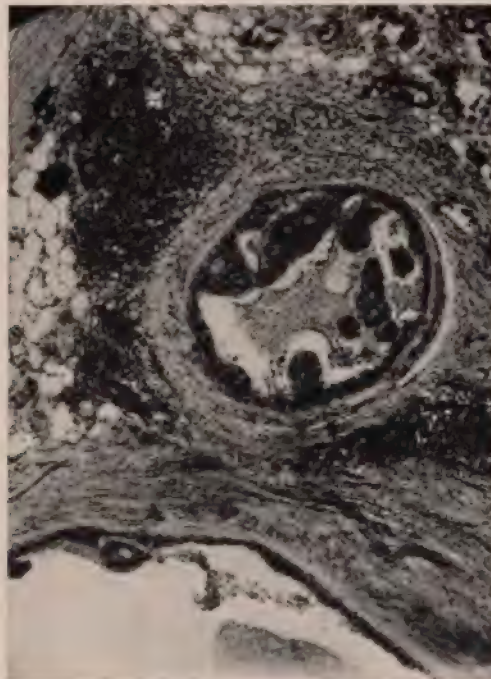


FIG. 491.—PHOTOMICROGRAPH (WRIGHT) FROM TUMOR IN FIG. 490.
Showing cystic adenocarcinoma and infiltration of breast stroma and fat with cancer epithelium.

axilla, the prognosis is 100 per cent. of cures; if mixed with scirrhus and there is metastasis to the axilla, the prognosis is 66 per cent. of cures.

Adenocarcinoma Beginning in a Cyst with an Intracystic Papilloma.—The benign prototype has been discussed. The malignant form occurs with equal frequency. When the tumor cannot be recognized as malignant (Fig. 493) at the examination, there should be little difficulty at the exploration. The bloody contents of the cyst would not aid, because this is present in the benign form; but the contents has usually been granular; the mulberry surface of the papilloma is lost and replaced by a fungous growth resembling a medullary carcinoma (Figs. 494, 495, 496). I believe that in every case the malignant nature can be recognized on opening the cyst. It will not be necessary to cut through the fungous growth and show its infiltration

into the surrounding breast. The prognosis, in the early cases, is good: five cures out of six cases—83 per cent. In one of the cured cases the axillary glands showed metastasis. In the case not cured the axilla was involved. In a seventh observation, in which only the breast was removed, there was local recurrence and death from internal metastasis.

When the entire breast about the cyst has become infiltrated with carcinoma, the prognosis is bad. We have observed no cures.

This malignant cyst has been observed in younger women—one aged twenty-seven. Usually the age of onset is over forty. The tumors may be of long duration—four to twenty years; usually, however, they are of shorter duration—less than

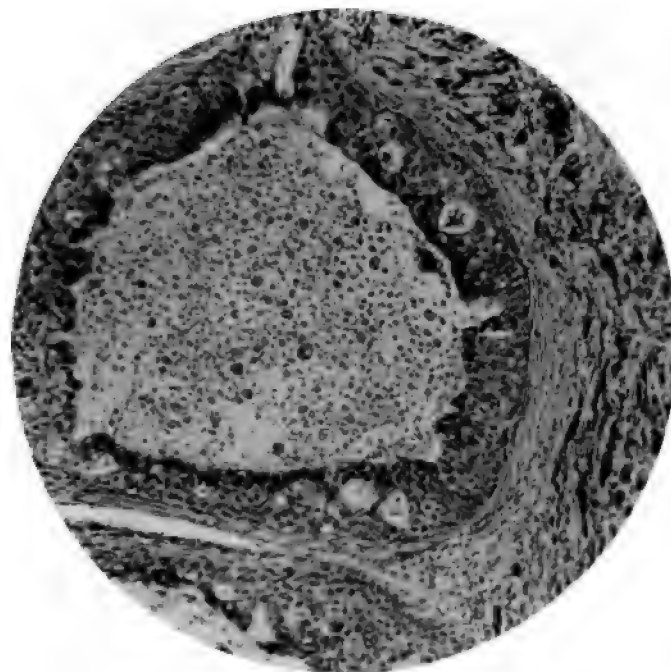


FIG. 492.—PHOTOMICROGRAPH (WRIGHT) TO ILLUSTRATE ADENOCARCINOMA BECOMING SCIRRHUS.

two years. A discharge of blood from the nipple is frequently noted in the clinical history. In the older cases the breasts are senile; in the younger—about forty—evidence of senile parenchymatous hypertrophy has been present; in one there were multiple cystic adenomata.

This study of adenocarcinoma is our best evidence that a single tumor in the breast should always be explored and that an incomplete operation for carcinoma should never be done. It is in this group that cures have been accomplished in tumors of long duration, even though ulcers and fungi had formed. The duration of life is long, as illustrated in one of the incomplete operations, after which the patient lived more than twelve years, with evidence of recurrence and general

metastasis, even to the scalp, which had been present for at least six years before death.

Medullary Carcinoma.—The relative frequency is slightly less than that of adenocarcinoma—13 per cent. The probability of a cure for three years is about 37 per cent.; about equal to that of the small infiltrating scirrhous and slightly less than the circumscribed scirrhous. Although the tumor grows rapidly locally, it does not infiltrate, like the scirrhous, and the proportion of inoperable cases is relatively very small—only a little greater than of adenocarcinoma.

The age of onset is more variable than in any other group—from twenty-eight to sixty-five. The cancer of the lactating breast is usually of the medullary type.



FIG. 493.—CYST WITH MALIGNANT PAPILLOMA.

Photograph of patient, Halsted's clinic. Female, aged seventy-two, tumor nineteen months. Clinically malignant (infiltration of skin); no metastasis to axilla. Cured five years.

About 7 per cent. of the medullary tumors have been clinically doubtful and were only recognized at the exploratory incision.

This tumor, in its onset, is small and circumscribed, rarely infiltrating, like a scirrhous. At the exploratory incision there is no capsule, and the soft, finely granular, friable tumor should never be mistaken for a benign lesion. Necrosis is always a prominent feature of the fresh appearance. In some of the tumors the stroma cannot be made out with the naked eye, and they look like sarcoma; in others the stroma is quite distinct.

For the purposes of prognosis I have divided the medullary tumor into the following groups:

Medullary Mixed with Adenocarcinoma-comedo.—In this tumor the typical

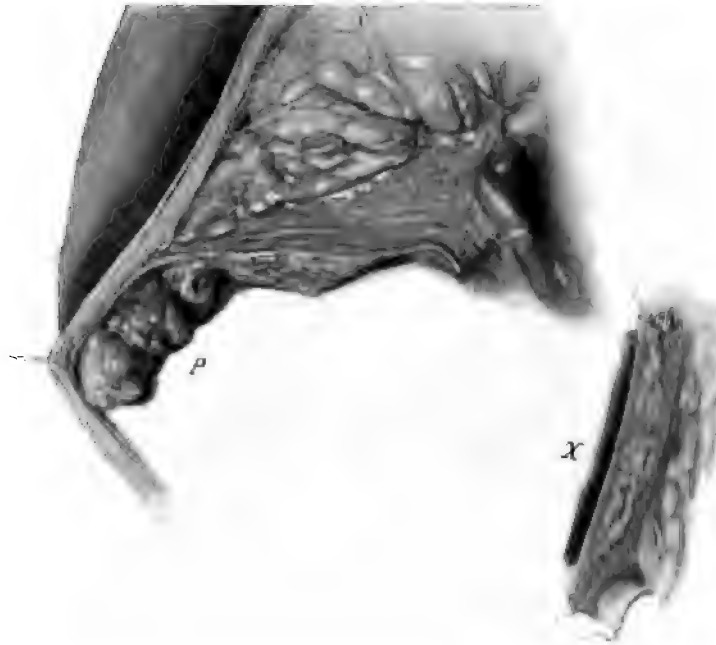


FIG. 494.—SKETCH OF SECTION THROUGH WALL OF CYST IN FIG. 493.
P, Papilloma; X, cancer in wall. Drawing by Horn, Halsted's clinic.

comedones can be expressed in a few areas and can be made out in the microscopic section. The relative prognosis is better—66 per cent. The age of the patients

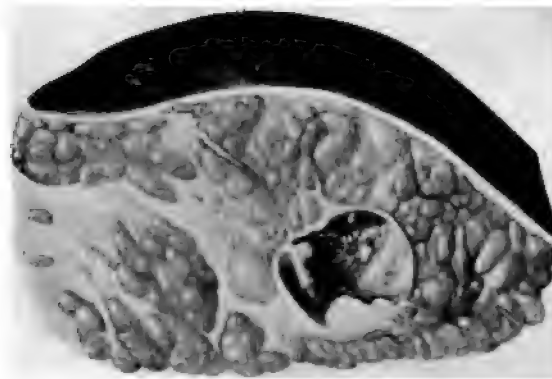


FIG. 495.—MALIGNANT PAPILLARY CYST.
Photograph from painting by Horn, Halsted's clinic.

is similar to that in the comedo group, and the breast is senile. The tumor may produce a fungus (Fig. 483)

Medullary Mixed with Adenocarcinoma Cystic.—This may be recognized in the fresh by the small cysts and spongy areas (Plate III). The probability of a cure is 80 per cent. All were clinically malignant (Fig. 497).

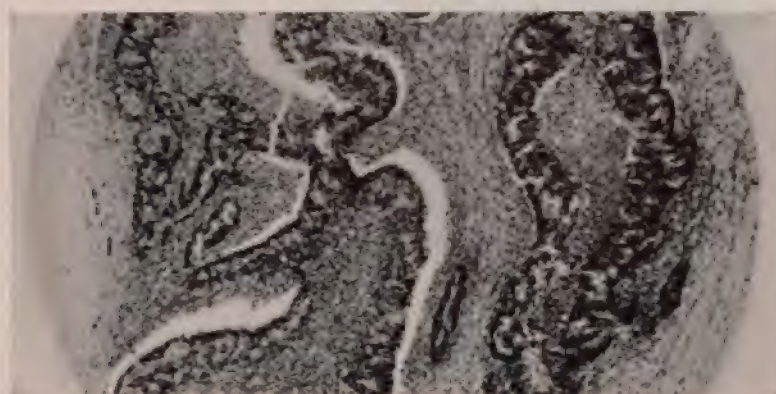


FIG. 496.—PHOTOMICROGRAPH (WRIGHT) OF ADENOCARCINOMA IN WALL OF CYST. (See Fig. 494, at X.)

In these two groups in which the medullary carcinoma may have been originally an adenoma or adenocarcinoma, the duration of the tumor in some of the cases—



FIG. 497.—MEDULLARY CARCINOMA.
Photograph of patient showing involvement of skin.

one, two, three, and four years—suggests an origin in a cancer of a relatively slow growth.

If these two groups of medullary carcinoma should be placed with adenocarcinoma, it would make the prognosis for medullary tumors much worse.



FIG. 498.—MEDULLARY CARCINOMA, HEMORRHAGIC TYPE.

Photograph of patient, Halsted's clinic. Female, aged fifty-eight, tumor four years; metastasis to axilla. Cured nine years.

Hemorrhagic Medullary Carcinoma.—In the fresh this circumscribed tumor is mottled with areas of old and fresh hemorrhage, like a thyroid tumor, and the

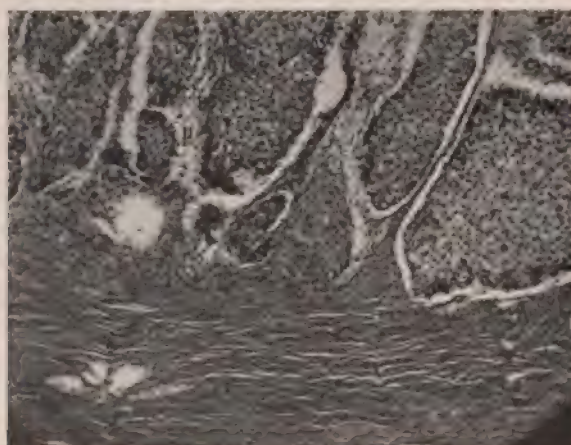
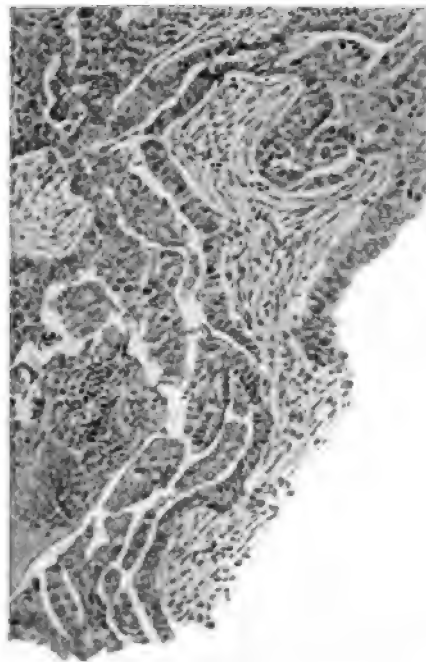


FIG. 499.—PHOTOMICROGRAPH (WRIGHT) OF MEDULLARY CARCINOMA.

evidence of blood can be demonstrated under the microscope, both in the stroma and in the epithelial alveoli. In some of the cases the histology resembles an endo-

thelioma. The prognosis is good—80 per cent. of three-year cures, 60 per cent. permanent cures (Fig. 498). It has been observed as a bilateral tumor and in the lactating-breast. The age of the women has varied from twenty-eight to sixty-five. The tumors were of four months' to four years' duration. In over 50 per cent. of the cases the axilla was not involved. Two cases were clinically benign and an exploratory incision was necessary.

Pure Medullary Carcinoma.—A soft tumor with sufficient stroma to be recognized with the naked eye, between which the tissue is granular, friable, and can be expressed on pressure. Under the microscope the epithelial cells are large (of the glandular type) and show no special arrangement in the alveolus (Figs. 499 and



L.W. NELSON Ford

FIG. 500.—MICROSCOPIC DRAWING OF MEDULLARY CARCINOMA.

500). The probability of a cure for three years is only 25 per cent. In none of the cured cases did the axilla show metastasis. The age of onset varied from twenty-eight to sixty. The majority of the tumors were of but a few months' duration, and all, with one exception, of less than one year. In two cases the tumor was in a lactating breast (Figs. 501 and 502), in the remainder the breast was senile. In about 12 per cent. of the cases the tumor was clinically benign, and in 10 per cent. the lesion was bilateral.

Medullary Carcinoma Resembling Sarcoma.—In the fresh these tumors are so cellular that they cannot be distinguished from a sarcoma. They are of rapid

growth: Figs. 503 and 504, give metastasis to the axilla early, and up to the present time have been incurable.

Scirrhus Carcinoma. For the purpose of diagnosis I have divided scirrhus

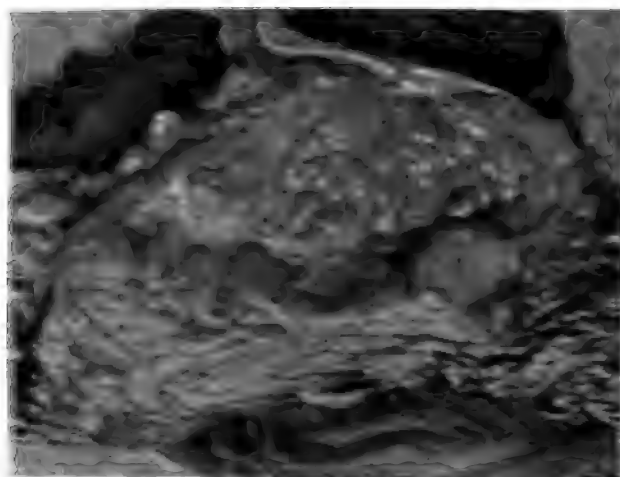


FIG. 503. Scirrhus carcinoma of the breast, showing metastasis to the axilla. (From the collection of the University of Michigan.)

into two groups, namely, the small (Figs. 505 and 506, Plate VII, Fig. 1), the small (Figs. 507 and 508, Plate VII, Fig. 2), and the large (Figs. 509 and 510, Plate VII, Fig. 3).

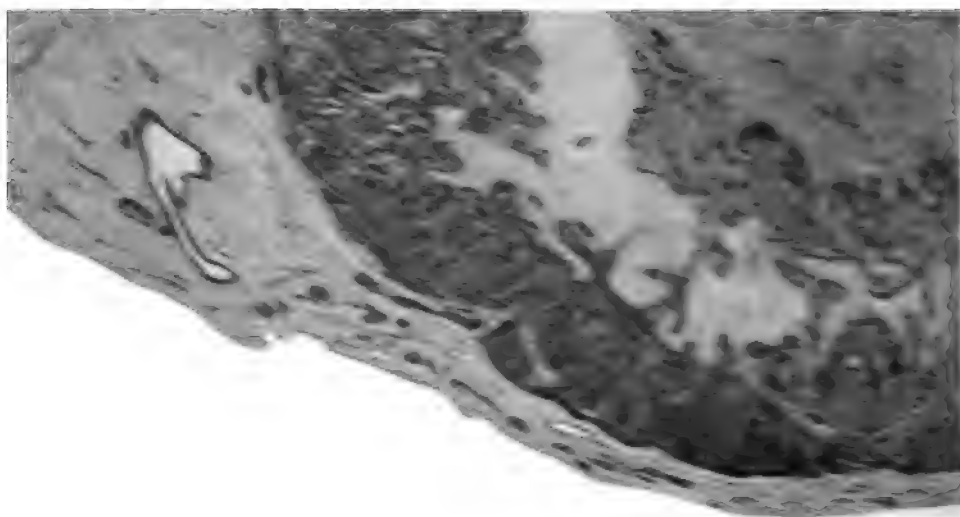


FIG. 505. Scirrhus carcinoma of the breast, showing metastasis to the axilla. (From the collection of the University of Michigan.)

The small (Figs. 505 and 506, Plate VII, Fig. 1), the small (Figs. 507 and 508, Plate VII, Fig. 2), and the large (Figs. 509 and 510, Plate VII, Fig. 3) scirrhus carcinoma of the breast, showing metastasis to the axilla. (From the collection of the University of Michigan.)

PLATE IV.



FIG. 1.—CIRCUMSCRIBED SCIRRHUS IN PERIPHERY OF BREAST, INFILTRATING FAT BENEATH SKIN.

The breast is fibrous and senile, and there are a few dilated ducts. Female aged seventy, tumor three months; malignant, based on atrophy of subcutaneous fat and retraction of nipple. Complete operation; metastasis to axilla. Death of regional recurrence three years. (Halsted's clinic.)

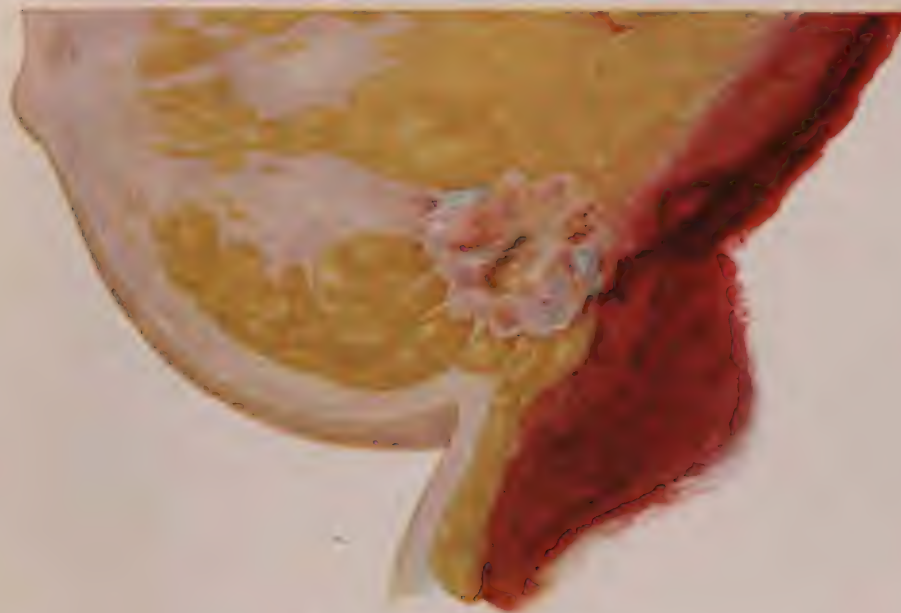


FIG. 2.—SMALL INFILTRATING SCIRRHUS.

Painting from fresh specimen, illustrating star-like tumor, dimpling skin, retracting nipple, infiltrating muscle; breast senile.



FIG. 501.—MEDULLARY CARCINOMA IN LACTATING BREAST.

Female, aged forty-four, tumor two years; metastasis to axilla. Death of mediastinal metastasis two years and eight months. Halsted's clinic.

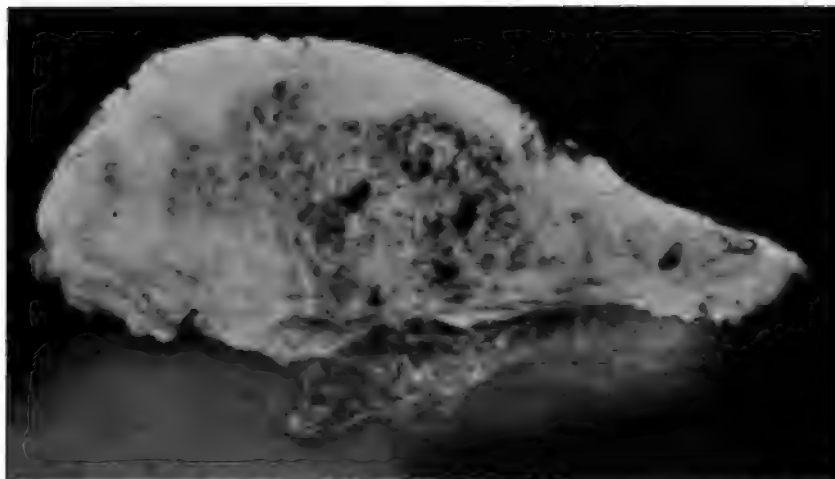


FIG. 502.—MEDULLARY CARCINOMA IN LACTATING BREAST.

Photograph from fresh specimen (Schapiro), section through breast.



FIG. 503.—MEDULLARY CARCINOMA, LIKE SARCOMA.
Not cured. Photograph of patient, Halsted's clinic.



FIG. 504.—MEDULLARY CARCINOMA, LIKE SARCOMA.
Not cured. Photograph of patient, Halsted's clinic.

growth (Figs. 503 and 504), give metastasis to the axilla early, and up to the present time have been incurable.

Scirrhus Carcinoma.—For the purpose of diagnosis I have divided scirrhus



FIG. 505.—CIRCUMSCRIBED SCIRRHUS, BASE OF BREAST, INFILTRATING PECTORAL FASCIA; BREAST NORMAL. Photograph from fresh tissue, section through nipple, breast, and muscle. Recent case.

into three groups: the circumscribed (Figs. 505, 506, and Plate IV, Fig. 1), the small (Figs. 507–510, and Plate IV, Fig. 2), and the large infiltrating scirrhus (Figs. 511,

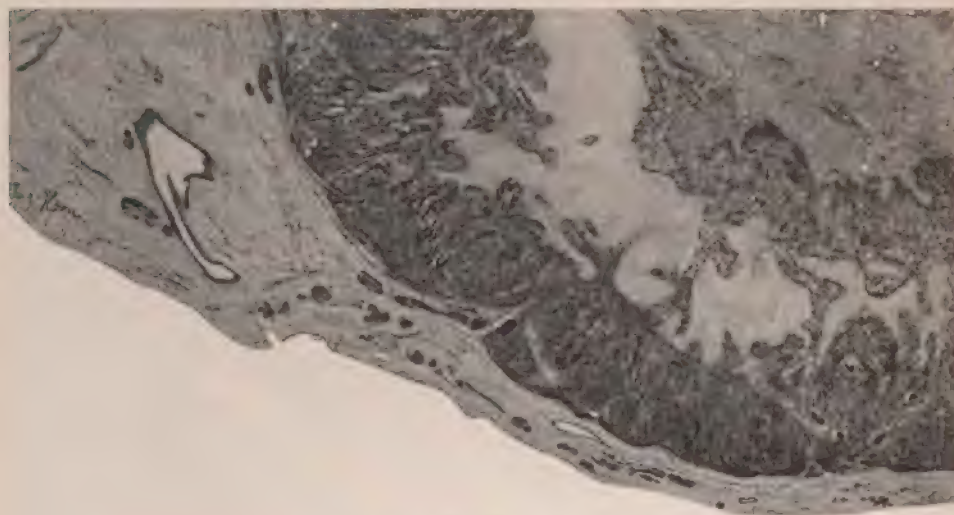


FIG. 506.—CIRCUMSCRIBED SCIRRHUS. Microscopic drawing by Horn, Halsted's clinic. Periphery of tumor cellular, center fibrous.

512, 513, 514, 515, 516). The fresh appearance of a scirrhus carcinoma, whether circumscribed or infiltrating, small or large, is the same. Perhaps its most characteristic feature is the gritty sensation which it gives to the knife, or to the palpating

PLATE IV.



FIG. 1.—CIRCUMSCRIBED SCIRRHUS IN PERIPHERY OF BREAST, INFILTRATING FAT BENEATH SKIN.

The breast is fibrous and senile, and there are a few dilated ducts. Female aged seventy, tumor three months; malignant, based on atrophy of subcutaneous fat and retraction of nipple. Complete operation; metastasis to axilla. Death of regional recurrence three years. (Halsted's clinic.)

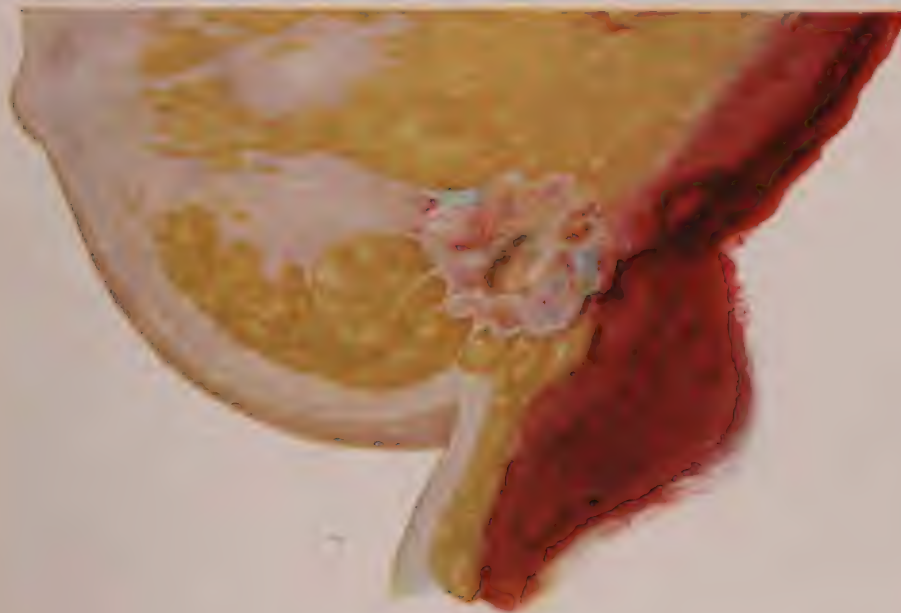


FIG. 2.—SMALL INFILTRATING SCIRRHUS.

Painting from fresh specimen, illustrating star-like tumor, dimpling skin, retracting nipple, infiltrating muscle; breast senile.



finger when an exploratory incision is necessary to make the diagnosis. I believe a surgeon should educate himself to recognize cancer by the sensation it gives to the knife or his finger.

The fresh appearance of scirrhus differs. If the alveoli of epithelial cells are comparatively large, with some necrosis, and the stroma quite fibrous (the fibrous form of scirrhus, Fig. 508), the yellow dots and lines in the fibrous trabeculae cannot be mistaken for any other disease. However, when the stroma is young, cellular connective tissue, and the epithelial cells are in small alveoli, the surface section shows very few distinct markings, and might be mistaken for inflammatory tissue.



FIG. 507.—SMALL INFILTRATING SCIRRHUS.

Photograph showing early dimpling of skin; tumor present but a few weeks in axillary quadrant. Photograph by Schapiro.



FIG. 508.—SMALL INFILTRATING SCIRRHUS, FIBROUS TYPE, OCCUPYING CENTRAL NIPPLE ZONE.

Photograph from fresh tissue (Schapiro), section through nipple, breast, and muscle. Note star-like contraction of surrounding tissue and the white dots and lines indicating epithelial necrosis. Patient, aged fifty-four, tumor six months; induration in center of breast with retraction of nipple; metastasis to axilla and muscle. Recent case.

This is the cellular type of scirrhus (Fig. 517). Its grittiness distinguishes it from inflammatory tissue.

We have observed a few scirrhus tumors under thirty—the youngest patient was twenty. The remainder are scattered between the ages of thirty and seventy-three. Scirrhus carcinoma is the most common tumor of the breast after sixty.

A scirrhus carcinoma, in my experience, assumes a clinical picture of malignancy within one year (Fig. 507). We have had a few exceptions. One, of five years' duration, a small infiltrating scirrhus, was still clinically doubtful, and was not recognized until the exploratory incision was made.

The inoperable carcinomata belong chiefly to the group of large infiltrating scirrhi. Of all forms of cancer, about 70 per cent. are scirrhous. The small infiltrating

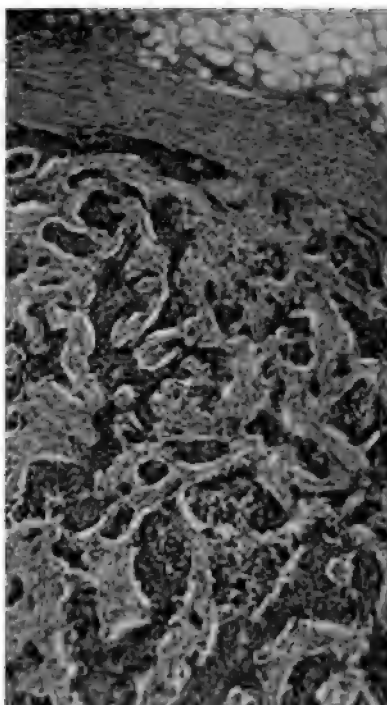


FIG. 509.—SCIRRHUS CARCINOMA.
Photomicrograph (Wright).

scirrhous is the most frequent—31 per cent.; the large, 29 per cent.; and the circumscribed, but 10 per cent. Only 18 per cent. of the large infiltrating tumors have been cured three years—37 per cent. of the small tumors and 42 per cent. of the



FIG. 510.—SMALL INFILTRATING SCIRRHUS IN LOWER PERIPHERY OF BREAST.
Photograph (Schapiro) to show adherent skin; position of tumor unusual.

circumscribed variety. The prognosis for a scirrhous carcinoma is, therefore, worse than that for the medullary. Late metastases are most frequent in this group.



FIG. 511.—LARGE INFILTRATING SCIRRHUS.

Photograph of patient to illustrate retraction of nipple and dimpling of skin. Patient, aged forty-seven, tumor eighteen months. Operation complete; no metastasis to axilla. Apparently well seven years and four months; died with symptoms of brain metastasis and fracture of neck of femur. Halsted's clinic.



FIG. 512.—LARGE INFILTRATING SCIRRHUS.

Photograph of patient to show retraction of nipple, dimpling of skin, slight atrophy of breast, retraction of breast to chest wall. Patient, aged forty-three, tumor ten months; complete operation; metastasis to axilla and neck. Death two years and six months; no external recurrence; symptoms of internal metastasis. Halsted's clinic.



FIG. 513.—LARGE INFILTRATING SCIRRHUS.

Photograph to illustrate retraction of nipple, lines of carcinoma infiltration radiating from nipple in skin; slight hypertrophy of breast; retraction of breast on chest wall. Patient, aged forty-two, tumor one and a half years. Complete operation; metastasis to axilla and neck; local recurrence in scar in one year; death. Halsted's clinic.



FIG. 514.—LARGE INFILTRATING SCIRRHUS.

Demonstrating the extreme infiltration of breast and skin; radiating cutaneous and subcutaneous involvement most marked in the upper and inner quadrant. Complete operation impossible. Death forty-eight days after operation of general carcinosis. Age, forty-six, tumor six months. An example of the most rapidly growing and fatal form of carcinoma. Halsted's clinic.

I am not prepared to state positively at this time, but my observations seem to demonstrate that the morphology of the cell in scirrhus carcinoma has a definite relation to its curability. In the majority of the permanently cured cases the cell is of the basal type, and the tumor has originated in senile breasts of older women.



FIG. 515.—LARGE INFILTRATING SCIRRHUS.

Photograph of section through breast and muscle of specimen in Fig. 514, by A. S. Murray.

Circumscribed Scirrhus.—Judging from the specimens sent to my laboratory the circumscribed scirrhus carcinoma is frequently mistaken for adenofibroma. I have a number of specimens in which this malignant tumor was excised on the diagnosis of a benign adenofibroma. In the majority of these cases the complete



FIG. 516.—LARGE INFILTRATING SCIRRHUS.

Photograph of fresh tissue, section through nipple, breast, and muscle (Schapiro). It illustrates the direct infiltration of the skin and nipple; a large zone of the skin about the nipple is involved; dilatation of ducts. Hopeless case.

operation was performed later, after the microscopic demonstration of its malignancy in the laboratory. As far as I have been able to ascertain, none of these patients has been cured. Less frequently a benign fibroadenoma has been treated on the diagnosis of a scirrhus carcinoma.

In the clinically doubtful tumors, as has been discussed (page 187), there should be no difficulty in distinguishing the encapsulated, hard fibroadenoma from the circumscribed scirrhous. I should advise, however, if there be any doubt and the patient is over thirty-five, the performance of the complete operation for cancer. I wish to warn against the use of the frozen section to differentiate the adenofibroma from the circumscribed scirrhous. It is much more difficult than from the fresh appearances. The irregular masses of atrophying epithelial cells in the old fibrous adenofibroma at first sight give the impression of cancer cells in fibrous stroma.

Atrophic Scirrhous.—In about 3 per cent. of all scirrhous carcinomata the tumor situated beneath or near the nipple is of very slow growth and associated with almost complete atrophy of the breast. If no operation is performed, the patients have been observed to live fifteen years; in my own observation not longer. The very late deaths—ten to fifteen years after operation—are observed in this type of tumor. I can find no evidence to support the general opinion that operation is contraindicated. In our few cases there is no evidence that it shortened life.

There must be a period in the disease in which complete removal will accomplish a cure.



FIG. 517.—CANCER CYST; CLINICAL PICTURE DOUBTFUL.

Photograph of patient from Halsted's clinic.

Cancer Cysts.—These are the most infrequent tumors of the breast—2.7 per cent. of all cases. Fifty per cent. have been clinically doubtful (Fig. 517) and exploratory incision had to be made; and it is very important to note that in all except one the diagnosis was not made, but only the cyst was excised, and later, upon microscopic examination of the cyst wall, a cancer

was recognized and the complete operation performed.

Only one of these cases is living, and as there is no pathologic report, the correct diagnosis may be questioned.

Cystic Tumors of the Breast.—The recognition, at the exploratory incision, of the solid tumors of the breast, has been fully discussed, and on the whole is less difficult than of the cystic. It seems best to review here the differential diagnosis, at the exploratory incision, of the various cystic tumors.

First, a cyst containing blood without a papilloma to explain the hemorrhage has, in my experience, always been cancer. A cyst containing thick, grumous material has always been cancer (Fig. 518). This material is due to broken-down epithelial cells.

The possible benign cysts of the breast are as follows:

The galactocoele (Fig. 440) has a thin, smooth, distinct wall containing milk, and is surrounded by lactating breast. The circumscribed chronic abscess (Fig. 461)—a rare lesion in the lactating breast (page 196)—has a thick wall lined by vascular granulation tissue and contains purulent material. This cyst will be most

difficult to recognize from the cancer cyst in the lactating breast. The walls look very much alike, but the contents of the cancer cyst is thicker and more granular.

The simple cyst has a smooth wall and thin, clear or cloudy, serous contents (Figs. 458 and 459). I have never observed it to be hemorrhagic. The cyst containing a benign papilloma may contain blood (Figs. 475 and 476). This can be



FIG. 518.—CANCER CYST: TYPICAL CANCER IN WALL AT X; BREAST SENILE.

Photograph from painting by Miss Hayes. The cyst contained typical, soft, granular, hemorrhagic cancer material (see Fig. 519).

distinguished, however, from the malignant papillomatous cyst by the changed appearance of the growth, projecting from the wall (Figs. 494 and 495) (page 234).

A careful review of my notes and the specimens of cancer cysts demonstrates that their contents have been either bloody, or thick, granular material (Fig. 519), that the wall is either thicker and more intimately adherent to the surrounding breast tissue than the benign cyst, and when, in a few instances, the wall has been found thin, a definite thickening could be palpated in some part of it, which on incision had the appearance of cancer.

In a sarcomatous cyst (Fig. 520) sent to me by Pancoast the cyst wall was lined by a friable, cellular tissue which would at once exclude a benign cyst.

In the fifth cancer cyst admitted to the surgical clinic, clinically doubtful, Halsted made the correct diagnosis at the exploratory incision from its bloody contents and from a palpable tumor in the smooth wall of the cyst. The complete operation was immediately performed. The axillary glands showed metastasis. This patient has remained well for the two years and six months which we were able to follow her after the operation.



FIG. 519.—SEE FIG. 518. PATIENT OF FINNEY.

The other clinically doubtful cancer cysts were received in the laboratory from outside sources.

I have recently observed two simple cysts in girls under twenty. Both followed traumatism. In one the fluid was slightly brown, but not definitely hemorrhagic; in both remains of an epithelial lining could be made out.

A lymphatic cyst, or a cyst due to a tubercular abscess, similar to those observed



FIG. 520.—SARCOMATOUS CYST OF BREAST.

Photograph from fresh tissue, section through cyst and breast; both halves of cyst shown. Note distinct cyst wall lined by friable granular tissue. Microscopic examination of wall—perithelial angiosarcoma. Female, aged fifty, tumor five and a half months; clinically benign; excision of breast only. Patient of Pancoast. (Schapiro.)

in the thigh, is possible. I have, however, never observed such a case, nor do I find any in the literature. The hydatid cyst and the benign and malignant dermoids have been discussed.

SARCOMA OF THE BREAST.

Although the breast is rich in stroma, malignant connective-tissue tumors are rare. Among 505 malignant tumors recorded in the laboratory, eighteen (3.3

per cent.) can be looked upon as true sarcomata. As half of these were obtained from outside sources, the percentage of cases admitted to the surgical clinic is about one. On the other hand, the benign fibroepithelial tumors are the most common lesions. Among 333 benign lesions of the breast, fifty-four, or 27 per cent., were intracanalicular myxomata, and twenty-eight, or 12 per cent., adenofibromata.

Some pathologists might classify with sarcoma the eleven cases which I have described as medullary carcinoma resembling sarcoma. These tumors were very cellular and had a distinct stroma. Clinically they were all malignant and of rapid growth, all showed metastasis to the axilla, none was cured.

Classification.—Among the eighteen cases of sarcoma which I have studied, the following distinct types may be recognized: the sarcoma arising in the intracanalicular myxoma, the primary sarcoma of the stroma of the breast (non-indigenous sarcoma), and the metastatic sarcoma.



FIG. 522.—SARCOMA IN BILATERAL HUGE INTRACANALICULAR MYXOMA.

Patient, aged forty-two, tumor of right breast twenty-five years; small and no growth for fifteen years; tumor of left breast three months. Complete excision of both breasts by Johnson, of Frederick, Md.

breast was removed there was rapid local recurrence in the muscle and death from pleural metastasis.

The patients, when the tumor has been malignant, have been between forty and fifty years of age, and the tumors of from two to eight years' duration, with a



FIG. 521.—SARCOMA IN HUGE INTRACANALICULAR MYXOMA. Photograph of patient. (Courtesy of Lilienthal, of New York.)

Sarcoma in Intracanalicular Myxoma.—During the same period I have observed fifty-four examples of the benign and seven (10 per cent.) of the malignant form of this fibroepithelial tumor.

With one exception the malignant tumor has only been found in the large intracanalicular myxoma involving half or the entire breast.

Of eighteen cases in which half or the entire breast has been occupied by this intracanalicular myxoma, six, or 33 per cent., have shown areas of sarcoma. For this reason every large intracanalicular myxoma should be regarded as suspicious and removed with an area of skin, a wider area of subcutaneous fat, and the entire major pectoral muscle. It is not necessary to remove the axillary glands. All cases so treated have been cured, while in two of the earlier tumors in which only the

history of recent rapid growth. In addition, in the majority the skin has been red and adherent—clinically malignant.

The large intracanalicular myxoma can be recognized by its distinct lobulation (Figs. 521 and 522). It may be bilateral, but its lobulation distinguishes it from diffuse hypertrophy. In the large tumors exploratory incision is never necessary.

In my only example of a smaller intracanalicular myxoma which has become sarcoma,—the patient was forty-six, the tumor of two years' duration,—it occupied the entire upper and outer quadrant and was clinically malignant, because palpation made out infiltration of the breast outside the circumscribed mass. This patient was cured after complete operation.

The small intracanalicular myxomata are rarely observed in the breasts of women over thirty. They can be recognized, however, at the exploratory incision. They do not differ from the tumor in younger women (page 216).

The malignant intracanalicular myxoma (Fig. 523) shows in places the characteristic lobulations of the benign tumor; in other areas, the myxomatous-cellular picture of a myxosarcoma. Under



FIG. 523.—GROSS APPEARANCE OF SARCOMA IN INTRACANALICULAR MYXOMA.

Photograph section through breast, alcohol specimen. Patient aged forty-six, tumor two years; excision of breast only; local recurrence in muscle and pleura two months after operation; death a few months later.

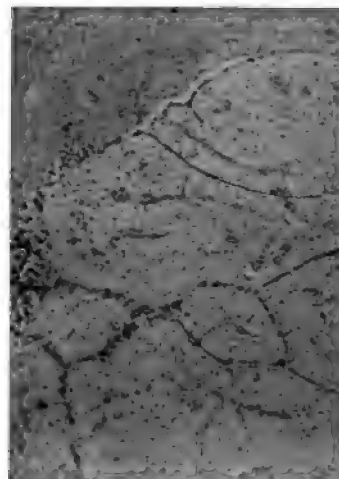


FIG. 524.—PHOTOMICROGRAPH (WRIGHT) OF INTRACANALICULAR MYXOMA AND SARCOMA.

Tissues from Johnson's case (see Fig. 522).

the microscope we can recognize, as a rule, in some places, the remains of the intracanalicular myxoma (Fig. 524); in other areas, spindle-cell and round-cell sarcoma (Fig. 525). In one of my cases cartilage and giant-cells were present.

Primary Non-indigenous Sarcoma.—Two have occurred as cysts in women aged thirty-seven and fifty, both clinically doubtful. These tumors could be recognized by the soft, friable tissue lining the wall of the cyst; in one the contents was hemorrhagic.

The solid tumors have all been clinically malignant and the complete operation for carcinoma performed without an exploratory incision. None have been cured.

One was a perithelial angiosarcoma in a woman aged fifty-five, with a rapidly growing tumor of two months' duration; the diagnosis of a malignant tumor was

based upon the marked edema of the subcutaneous fat. Two were rapidly growing fibro-spindle-cell sarcomata of from two to nine months' duration in women over seventy; both clinically malignant on account of the infiltration of the surrounding skin.

The non-indigenous sarcoma, on account of its rapid growth, will resemble clinically the medullary carcinoma, and the same complete operation should be performed. So far, the prognosis has been hopeless. Should these tumors be seen early, when clinically doubtful, their cellular nature will undoubtedly be easily recognized at the exploratory incision.

Metastatic Sarcoma.—Three cases were observed, all in women under twenty; multiple tumors, of rapid growth in one or both breasts. The primary growth was in the tonsil in one case, in the ovary in two cases. When the primary lesion had given no evidence of its presence, the diagnosis was not made until one of the tumors had been explored.

DISEASE OF THE AREOLA AND NIPPLE.

Primary lesions of the nipple, skin, of the areola, and over the breast are comparatively infrequent. The two most com-



FIG. 525.—PHOTOMICROGRAPH (WRIGHT) OF PURE SARCOMATOUS AREA FROM SAME BREAST AS FIG. 524.

mon are congenital depression and infections of the nipple during lactation. Absence of the nipple is always congenital, bilateral, with few exceptions; in some cases the breast is fully developed. Women with congenital depressions of the nipple may be unable to nurse their children; if nursing is attempted, injury and infection of the nipple are more common. Unusual care should be exercised in these cases. Some authorities on obstetrics advocate in cases of depressed nipple a treatment during the pregnant stage which consists of an attempt to overcome the depression by pulling the nipple forward or covering it with a cup. During lactation extreme care in cleanliness of the nipple and mouth of the child usually prevents the infection of the nipple. The first lesion is a traumatic abrasion of the epidermis. If this is untreated, fissures form, then ulcers, and later a fungus due to exuberant granulation tissue. At any time a mastitis is possible from an infection along the lymphatics that come

from the lacteal ducts. In the treatment cleanliness is of the first importance; second, protection of the nipple, during nursing, with a shield. In advanced cases nursing will have to be discontinued. In the simple abrasion and fissure mild antiseptics with a dressing of dry powder after each nursing is sufficient. In the ulcer and fungous stage the lesion should be disinfected with pure carbolic acid followed by alcohol or nitrate of silver.

Paget's Disease.—In 1874 Paget¹ described a chronic eczema of the nipple observed in women between forty and sixty, which was usually associated with ulceration of the nipple. In every one of his cases a tumor of the breast developed. It was situated beneath or not far from the nipple, but there was always a zone of apparently healthy tissue between. Paget viewed the lesion of the nipple as primary, and although he had never observed such a case, he was inclined to the opin-

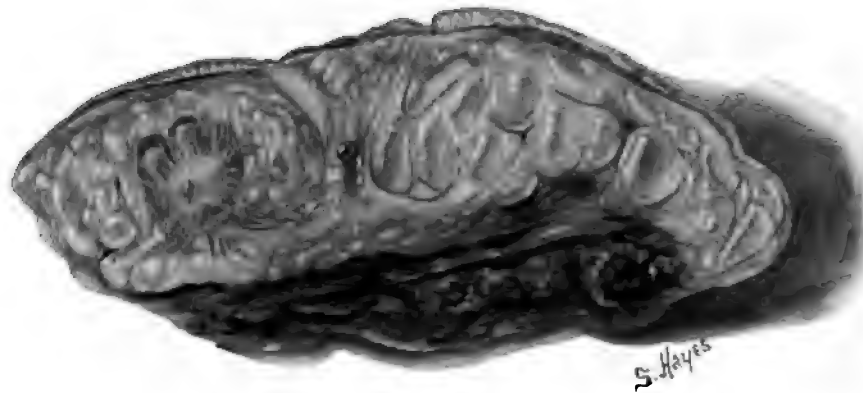


FIG. 526.—SMALL INFILTRATING SCIRRHUS TO LEFT; DIRECT INFILTRATION OF CARCINOMA THROUGH BREAST TO NIPPLE WITH DESTRUCTION OF NIPPLE BY A CARCINOMATOUS ULCERATING PROCESS.

Question as to Paget's disease. Photograph from painting of fresh section through nipple and breast. Patient aged fifty-five, eczema and ulceration of nipple two and a half years; tumor noticed but five months. Complete operation; metastasis to axilla. Recent case. Patient of Pancoast.

ion that in some instances the area of eczema might heal without the development of a carcinoma in the breast. Since then the literature on this subject has been scanty, as observations of this kind are unique. Ehrhardt,² in reporting one observation, considered that the eczema of the nipple which had been present two years before the tumor of the breast had been observed was the primary lesion. In the most recent communication by Schambacher³ an opposite view is maintained; that is, that the tumor of the breast is the primary lesion, and the changes in the skin of the nipple and areola are secondary, due to the infiltration of the cancer cells directly upward from the tumor, or by metastasis along the ducts or lymphatics. I have never observed a case of cancer of the breast in which a primary epithelioma of the nipple could be considered the origin of the neoplasm. I have observed a

¹ Paget: St. Barth. Hosp. Rep., x, 87.

² Ehrhardt: Deutsche Zeitschr. f. Chir., 1900, liv, 130.

³ Schambacher: Deutsche Zeitschrift. f. Chir., 1905, lxxx, 332.

few cases clinically answering the description of Paget's disease, but a pathologic investigation led to the same conclusions as those reached by Schambacher. Fig. 526 shows a section through the nipple and breast of a patient of Pancoast which was considered clinically an example of Paget's disease. The apparently free interval between the tumor and ulceration of the nipple described by Paget is well marked.

For practical purposes I should advise that every case of chronic eczema with ulceration of the nipple in a woman at the cancer age be treated as a carcinoma, even though a breast tumor cannot be palpated, unless the appearance of the ulcer or the presence of other distinct lesions allows a positive diagnosis of syphilis.

Other Lesions of the Areola or Nipple.—These are best described by Sheild.¹ They are very rare. I have observed one pedunculated papilloma of the nipple similar to the one pictured by Sheild, and one encapsulated solid adenoma. Cysts of the glands of Montgomery have been reported. These unique tumors are not difficult to recognize. Primary and secondary syphilitic lesions of the nipple, as a rule, present no difficulties in diagnosis. Primary benign and malignant tumors of the skin of the breast are unusual.

STATISTICS AS TO ULTIMATE RESULT AND DURATION OF LIFE IN MALIGNANT TUMORS.

Life After Operation.—Fifty-five patients are living from three to fifteen years after operation. The average number of years since the operation of these patients is 8.45. Twenty-two patients died of old age, or of intercurrent diseases with no evidence of a return of the cancer: eight of these within three years after operation, sixteen from three to ten years after operation.

Among 213 complete operations in which a period of from three to fifteen years has passed, recurrent carcinoma, not in the region of the wound, has taken place and caused death in fifteen patients. These late recurrences have been observed from three to eight years. The average duration of life has been 6.9 years. I wish to emphasize the fact that statistical figures seem to show that the patient who remains free from evidence of carcinoma after operation for eight years may be considered permanently cured. Later recurrences have been recorded in the literature, but may be looked upon as exceptions.

Local Recurrence.—In Halsted's clinic, after the complete operation, local recurrence in the scar of the chest, axilla, or neck is comparatively rare. It has taken place in twenty-three cases; that is, in about 10 per cent.

We have never observed local recurrence after three years, and, with few exceptions, the recurrence has taken place within eighteen months. The average duration of life after operation on patients dying with local recurrence has been but 2.26 years, evidence not only of the malignancy of the tumor, but of its extensive local infiltration at the time of the operation. Whether there has been a personal element in a somewhat restricted operation is difficult to estimate, but I frequently

¹ Sheild: Loc. cit.

find in the operative note and in my pathologic descriptions the statement that a smaller area of skin than usual has been removed.

Regionary Recurrences.—Recurrences outside of the scar of the operation, which cannot be explained by any restriction in the complete excision, have taken place in about forty-one cases, or about 20 per cent., and the average duration of life in these cases is 2.16 years.

Internal Metastasis.—Fifty-seven patients have died between a few months and four years after operation with definite symptoms of internal metastasis, which have always been present within three years after operation.

These figures are of great interest. Among 121 patients who developed signs of local, regionary recurrence or internal metastasis the average duration of life is less than two and a half years, the longest six years, the shortest three months. Twenty-one of these cases, or 17 per cent., lived three years or more after operation. If we add to these the fifteen who died of regionary recurrence after three years, we find that 26 per cent. of patients who ultimately died of the disease lived more than three years following operation; the longest period of apparent freedom has been eight years, the longest duration of life twelve years.

The average duration of life, therefore, of patients upon whom the complete operation for cancer has been performed (and not cured) is about four and a half years.

Inoperable Cases.—In fifty-five patients an operation was attempted, but abandoned because of infiltration of the disease beyond any possible complete eradication. The average duration of life in this group is about 1.4 years, as compared with 4.7 in which the complete operation was performed without a permanent cure. Complete excision, therefore, if possible, prolongs life.

Inoperable; No Operation.—In sixteen cases the disease had reached such a stage that no operation was performed. The duration of life in this group, after the onset of the disease, was 3.2 years, as compared with 2.2 years in inoperable cases in which an operation was attempted; that is, an incomplete operation not only shortens life after the operation, but the probable period of life from the onset of the disease.

Notwithstanding this fact, I am of the opinion that the complete operation should be attempted if there is any shadow of hope, and, in addition, in certain cases it seems justifiable, when the tumor is adherent to the chest wall, to resect ribs and sternum at the primary operation.

This more extensive operation should be selected for those forms of adenocarcinoma and medullary carcinoma in which, although the tumor extends locally and involves intercostal muscles and the chest wall, this local infiltration is apparently not associated with internal metastasis.

Life After Onset of the Disease.—It is interesting to study the complete duration of life from the onset of the first symptom (tumor) to death in those cases in which the carcinoma has been the cause of death. To ascertain this, one adds the duration of the tumor before operation to the time which the patient lived after operation.

In patients who have died with metastasis three years or more after operation the average total duration of life has been 8.26 years, as compared with life after operation of 6.9 years; that is, the average duration of the tumor before operation was 1.36 years. When this is compared to the average duration of the tumor in patients cured, we find that the tumor in the former (not cured) has been present longer—by about three months. This is the best evidence that I can find of the importance of an early operation. The longest duration of life in a patient who developed metastasis after three years has been thirteen years.

When we study the total duration of life in patients who developed local or regionary recurrence or internal metastasis before three years after operation, we find that it is less than four years, and the average duration of the tumor is again found to be a few months longer than in the patients who died of metastasis which did not manifest itself until after three years following operation.

Again, when we study the total duration of life in the cases in which the operation was abandoned on account of hopeless infiltration, we find that it is less than two and a half years, and the average duration of the tumor before operation longer.

These figures demonstrate that next to the pathology of the tumor, the duration of the disease, before its operative removal, is the most important factor in the probability of an ultimate cure.

The average duration of life of a cancer of the breast from the onset of the disease to death is but 3.77 years. It is possible for cancer of the breast to produce death within six months, but this is unusual (less than 1 per cent.). Fifty-six per cent. died within three years, but 41 per cent. lived from three to eight years; 12 per cent. lived from five to eight years, and 3 per cent. from eight to sixteen years. The few observations of a duration of life longer than nine years are of the so-called atrophic scirrhus variety.

I emphasize these figures because I feel that the profession is not aware of the latency or slow growth in the large percentage of cases of carcinoma of the breast.

Recurrent Carcinoma of the Breast.—Among the cases of recurrence observed in Halsted's clinic after the complete operation, second operations have been performed in a number of instances. Not a single case has been permanently cured, although in three the patients remained apparently well for three years.

I am of the opinion that a local or regionary recurrence, after a complete operation properly performed, is evidence of a wide-spread dissemination of the disease at the time of the first operation.

Incomplete Operations.—In a few cases in the surgical clinic the tumor or breast only has been removed, and later, after the microscopic diagnosis of cancer, with few exceptions the complete operation performed. Among these cases there is but a single cure, although in the majority the tumor belonged to the least malignant form of cancer. This I have discussed under Adenocarcinoma.

During the same period forty-eight patients were admitted to the clinic, or tissues were received in the laboratory, of recurrent carcinoma after an incomplete

operation performed elsewhere. In some the tumor only was removed; in others, the breast; in a very few a partial axillary operation was performed. In only sixteen (25 per cent.) was a complete removal of the recurrent tumor possible. Among these cases there are but two that were permanently cured: a comedo and a colloid adenocarcinoma.

The evidence of my observation demonstrates that in no form of carcinoma is an incomplete operation justifiable.

OPERATIVE TECHNIC.

The various operations may be divided into: (1) Incision and drainage of an abscess; (2) exploratory for diagnosis; (3) excision of single or multiple tumors; (4) excision of breast; (5) the complete operation for carcinoma; (6) the modified operation for sarcoma arising in a large intracanalicular myxoma.

Preparations for Operation.—With the exception of an abscess secondary to lactation mastitis, all other patients suffering with breast lesions should be prepared for narcosis and the complete operation for cancer.

When the tumor is clinically malignant, the patient should be narcotized before the operation is begun. When the tumor is clinically doubtful and the age of the patient and palpation of the tumor favor a benign lesion, the exploratory incision may be done under local cocain anesthesia. If the evidence favors the probability of a malignant tumor, ether should be given.

The axilla should always be shaved. When the patient's general condition is not good and the chances are that the complete operation will have to be performed, it shortens the anesthetic time to prepare the skin before ether is given.

1. Incision and Drainage of Abscess.—If possible, the incision should be made below a horizontal plane through the nipple. As a rule, this can be performed under cocain anesthesia. In late cases the pus may be encountered the moment the skin is divided. In earlier cases (the best time to operate) one divides skin and subcutaneous fat, exposing the breast tissue. The presence of the inflammatory focus is indicated by edema and infiltration of the breast tissue. Now and then, before incising the breast, an aspirator should be employed to locate the pus cavity. Before incising the breast it should be infiltrated with cocain solution. After opening the abscess cavity it affords better drainage to excise a piece of breast tissue. In the majority of early cases this is sufficient. In very acute cases, in which there is considerable infiltration beyond the pus cavity, it is safer to divide the posterior wall of breast tissue and expose the space between the breast and pectoral fascia. The gauze drainage is then placed through the abscess into this space. This procedure prevents the formation of a submammary abscess, which not infrequently is observed secondarily to the simple anterior incision. If the abscesses are multiple, each should receive similar treatment. In chronic pyogenic abscesses the wall composed of granulation tissue and a base of fibrous tissue should be excised. It is very easy to demonstrate non-infected lactating breast tissue. Both in acute and

chronic infections the inflamed tissue when incised does not weep milk; the non-inflamed tissue does.

2. **Exploratory Incision for Diagnosis.**—The incision should be made directly over the tumor, through the skin and subcutaneous fat; carefully clamp all bleeding points and inspect the tissue as it is cut. Quite frequently a cancer can be recognized by the point of the knife before it is seen. When the diagnosis of malignant tumor has been made, the wound is swabbed with pure carbolic acid or cauterized with Paquelin and closed. Now the complete operation is performed just as if an exploratory incision had not been made.

If the exposed tumor is benign, it should be removed. In doing this one has an opportunity to inspect the appearances of the surrounding breast tissue.

3. **Excision of Tumor.**—Whether cystic or solid, it is better to remove the tumor with a small zone of breast tissue. In removing the cyst, which of course has been opened for diagnostic purposes, place the finger of the left hand within the cyst and clamp the edge of the cyst wall; this will facilitate the dissection. Always carry the excision through to the pectoral fascia. To close the wound approximate the breast tissue with continuous catgut accurately and close the skin separately. Drainage is not indicated.

Breast tumors can readily be removed under cocain anesthesia. It will be necessary to infiltrate the breast tissue as well as the skin before making the incision.

Multiple Tumors.—I have always removed multiple tumors through a separate incision for each tumor. However, Warren's procedure¹ appeals to me as having certain advantages for the excision of multiple cysts in older women. At the present time I am not prepared to recommend it for the excision of a single tumor. The skin incision is carried through the subcutaneous fat until the pectoral fascia and muscle are exposed along their lower border. The mammary gland is separated from the pectoral fascia and reflected against the upper portion of the chest. This exposes the posterior surface of the mammary gland. The cysts can be seen or felt and are removed by a wedge-shaped excision. The defect in the breast tissue is closed in a way similar to that described after the excision of a single tumor, except that the anterior sutures are made first. The breast is then replaced and sutured to the pectoral muscle and the skin incision closed.

I have used this method only once in the removal of a medium-sized adenofibroma situated in the center of the left breast of a girl aged sixteen. The procedure requires anesthesia. The incision must be longer. In this case there was a resultant keloid which required secondary operations. For the removal of a single tumor I am of the opinion that the method described here will be found to be simpler and, on the whole, better than the plastic resection of Warren.

For multiple cystic tumors in the breasts of older women Warren's operation meets the indications in a very satisfactory way and is less mutilating than the complete excision of the breast. One, however, must be quite sure that the breast contains none of those areas which might develop later into carcinoma.

¹ Warren: Loc. cit.

4. **Excision of the Breast.**—When the exploratory incision into the tumor demonstrates a cyst with a benign papillomatous growth, or an area of senile parenchymatous hypertrophy in which adenocystic changes are marked, the entire breast should be removed. In the latter instance, it is my opinion that both breasts should be removed. In removing the breast there is no advantage in preserving the nipple. The nipple should be situated in the center of a small elliptical area of skin which is removed with the breast. The direction of the skin incision including this area should be an oblique line from the sternal edge of the lower and inner quadrant to the axillary border of the pectoral muscle. These skin flaps are dissected with the subcutaneous fat from the breast. The upper flap is dissected until the pectoral muscle is exposed above the breast. Then the breast with the pectoral fascia is dissected from the pectoral muscle from above downward and from the axillary border toward the sternum. One will always find a projection of the breast tissue passing into the axillary fat below the border of the pectoral muscle. This should be removed with some surrounding fat. A few vessels will be exposed here. In separating the breast from its sternal border one encounters the perforating branches of the internal mammary artery. If the breast and the pectoral fascia are separated by blunt dissection and the breast lifted and drawn downward and outward, these vessels are easily exposed and can be clamped before they are cut. In this dissection, as one leaves the subcutaneous fat with the skin and makes the incision near the breast tissue, the operation is even more bloody from oozing than the complete operation for cancer, in which the subcutaneous fat is dissected from the skin and left with the breast. It is important to ligate all bleeding points. Even with careful hemostasis there is usually some post-operative oozing, and if the wound is closed without drainage, a hematoma is not infrequent. For this reason these wounds should be drained. I prefer one or two pieces of rubber tissue. The method of closure of the skin is unimportant. The operator can follow his usual procedure. To facilitate the escape of fluid I prefer, in addition to the drainage, the interrupted skin suture. In dressing the wound considerable loose gauze should be employed, with which the axilla is well padded, and this gauze should be held in place with a firm bandage about the chest, including the shoulder on the operative side. For at least five days the forearm should be carried in a sling and the arm fixed to the side of the body to prevent use of the pectoralis major muscle.

When the breast must be excised for tuberculosis or chronic pyogenic mastitis with sinuses, the skin incision varies to include the sinuses, and the deep dissection should be made beyond the infected tissue.

The axillary glands are removed in these infected cases only when they are involved, and, as a rule, in these cases, the axillary dissection can be performed without division of the pectoral muscle. In very extensive cases of tuberculosis with involvement of the pectoral muscle and extensive involvement of the axillary glands the complete operation for carcinoma may be required to remove all the infected tissue. I found this necessary in only one case.

The two most important points in the removal of the breast are the dissection

of the pectoral fascia with the breast, which is done simply to facilitate the operation, and the drainage of the wound.

5. The Complete Operation for Cancer.—The conception of this now accepted procedure should be credited to Halsted.¹ The scheme has in view a block dissection of the breast with its skin covering, a wider area of subcutaneous fat, both pectoral muscles, and the entire axillary contents in one piece.

Carcinoma, as stated before, is unicentric in origin and extends by local infiltration along lymphatic vessels, the sheaths of blood-vessels, and the fascia.

We have no means of ascertaining in what direction a cancer of the breast has infiltrated. The area removed in the Halsted operation is designed to block all the possible directions of infiltration.

Steps of the Operation.—Space forbids an anatomic discussion. Before performing this operation one should practise it on a cadaver and study the anatomy of the breast, chest-wall and axilla, and supraclavicular fossa.

The operation consists of the following steps: (1) Position of the patient; (2) the skin and subcutaneous fat incision; (3) the division of the pectoralis major muscle; (4) the division of the pectoralis minor muscle; (5) the axillary dissection; (6) the supraclavicular dissection; (7) the closure of the wound.

Position of Patient (Fig. 527).

—As the operation is long, the patient should rest upon a mattress. The plain of the axilla is raised by a bran bag beneath the scapula. It is very important that after cleansing the skin the back of the patient be dried. Pressure necrosis has taken place from lack of this precaution. The arm is held by an assistant at a right angle from the body. The surgeon must constantly watch that the arm is never overextended. The danger of overextension is most marked after the division of the muscles. Post-operative monoplegia is due to overextension.

Anesthesia.—Ether by the drop method is the most satisfactory. The narcosis after the skin incision should be unusually light, and very little anesthetic is required. Toward the end of the operation when the skin grafts are cut the narcosis should be deepened for a few minutes.

Skin Incision.—This is influenced by the position of the tumor and the situation of the breast on the chest wall. The tumor should be given a wide area and the skin over the breast should be removed.



FIG. 527.—POSITION OF PATIENT. (Photograph by Schapiro.)

¹ Halsted: *Annals of Surgery*, Nov., 1904.

The first incision (Fig. 528) begins over the insertion of the pectoralis major on the arm, and curves over the chest above the breast to the sternum, and extends down between sternum and breast; if possible, the level of this incision should be a little below the border of the pectoralis major over the axilla, and then rise again as it approaches the breast. When the tumor is in the axillary quadrant, this incision must be higher. The second incision extends from the junction of the middle and inner third of the clavicle toward the nipple, and divides the skin above the first incision into two infraclavicular flaps—an outer and an inner. These two flaps are dissected, leaving the subcutaneous fat with the muscle, until the pectoralis major muscle is exposed to its clavicular bundle below the clavicle and to the sternum.



FIG. 528.—SKIN INCISION.
Diagrammatic sketch.

Division of the Pectoralis Major.—The tendinous attachment to the humerus is isolated and divided transversely to its fibers (Fig. 529). I prefer to insert my finger from below upward and to slowly follow the knife. One must be careful of the axillary vein, which lies just below the muscle at this point. Grasping this portion of the major pectoral muscle, it is separated by blunt dissection from the clavicular bundle up to the sternum. In making this blunt dissection one meets branches of the acromiothoracic arteries (Fig. 530), which should be ligated close to the muscle. The proximal ends of these vessels and their surrounding fat are gently pushed back (Fig. 530). The pectoralis major muscle and the breast are gently reflected outward and downward. The left hand is now inserted beneath the

pectoralis major muscle and the latter divided from its sternal attachments from above downward (Fig. 530). The left hand is used to gently separate the muscle from the chest wall and to make tension during the division of the tissue. The perforating branches of the internal mammary artery are doubly clamped before they are divided. When this division of the muscle is complete, the proximal ends of these arteries are ligated. When the tumor is small and situated in the outer

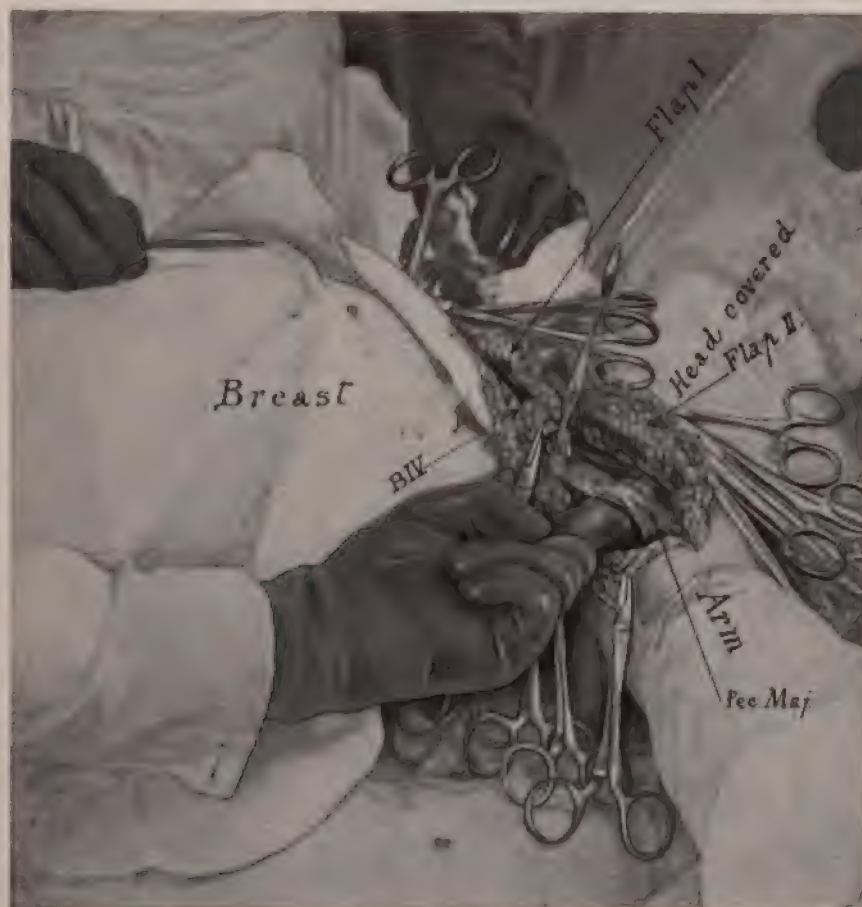


FIG. 529.—DIVISION OF PECTORALIS MAJOR TENDON.

Flaps I and II (See Fig. 528); BIV, fat to the upper and outer quadrant of the breast. Photograph of operation by Schapiro.

hemisphere, one may leave a stump of 1 to 2 cm. of this muscle attached to the sternum. If the tumor is an infiltrating one and situated in the inner hemisphere, the muscle must be divided close to the ribs and sternum. I am quite confident that frequently along the sternal border of the breast, in skin, subcutaneous fat, and muscle, sufficient margin of uninvolved tissues is not included in the excision in these cases in which the infiltrated tumor is situated in the inner hemisphere of the breast.

In making this more extensive dissection one will find more difficulty in clamping the perforating branches of the internal mammary artery.

The breast and major pectoral muscle now can be reflected outward and downward against the side of the body, exposing the pectoralis minor muscle and axilla (Figs. 531 and 532).

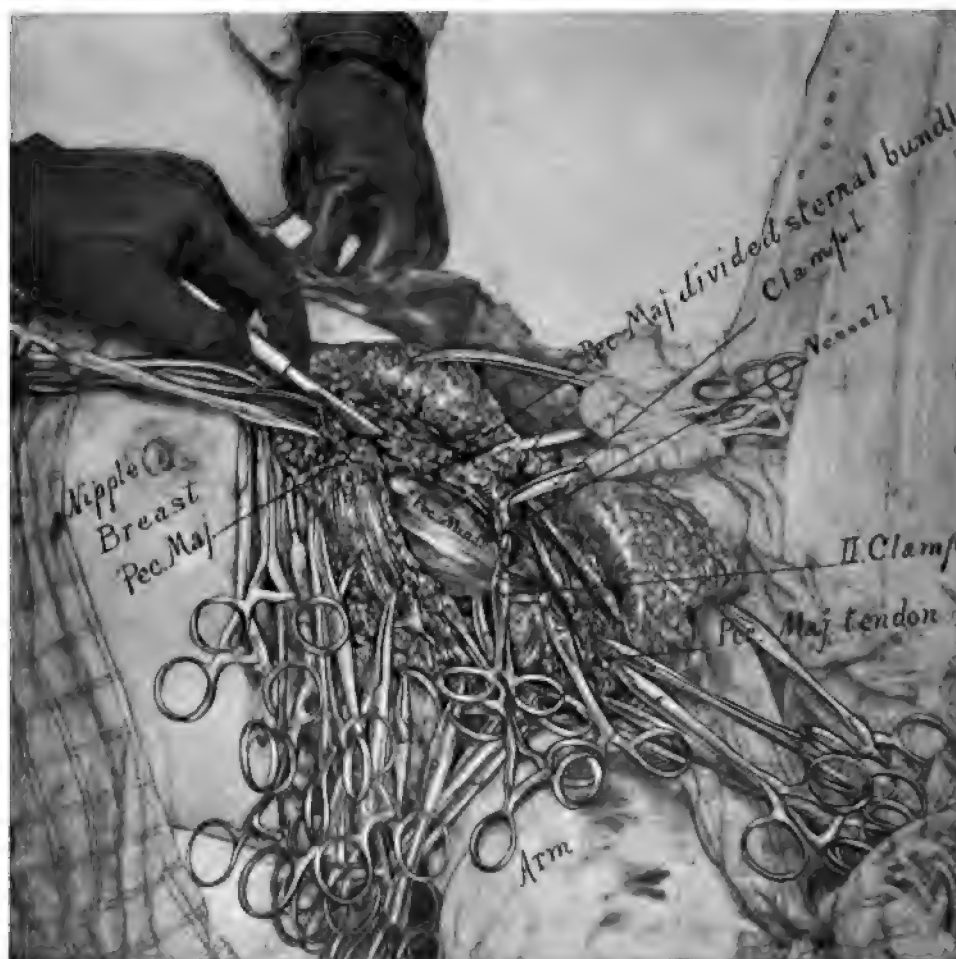


FIG. 530.—DIVISION OF PECTORALIS MAJOR MUSCLE FROM ARM TO A POSITION ONE-THIRD OF THE WAY ALONG THE STERNUM.

The hand mentioned in the text which is placed beneath the muscle is not shown. Vessel I, branches of the acromiothoracic vessels and fat which pass between the two pectoral muscles and which are not divided. Clamp I on the proximal end of these vessels after their separation from the pectoralis major muscle. II Clamp, axillary edge of pectoralis minor muscle. Photograph of operation by Schapiro.

This method (known as Meyer's modification)¹ is the best when operating upon the right side; however, on the left side it is more convenient to begin at the sternum and divide the muscle in the opposite direction.

¹ Jour. Amer. Med. Assoc., July 29, 1905.

The skin incision is now extended along the lower and inner quadrant and out toward the axilla along the lower hemisphere of the breast.

Division of the Pectoralis Minor (Figs. 531, 532, 533, 534).—One always finds, crossing this muscle from the apex of the axilla to the tissue of the axilla, on the lower border of the muscle, a branching artery and accompanying veins. These vessels are surrounded by fat, always contain lymphatic vessels and tissue, and not infrequently cancer nodules.



FIG. 531.—DIVISION OF PECTORALIS MINOR MUSCLE.

Photograph of operation. The minor pectoral is first separated from its sternal origin. Clamps I and II and Vessel I same as in Fig. 530.

I prefer not to divide them, but by gentle blunt dissection to push these vessels away from the tendinous attachment. This is easily done. There are no vascular branches entering the muscle. The finger is then introduced from above down beneath the pectoral minor muscle and the latter divided near the coracoid process. As a rule, one vessel is encountered. The muscle is again divided, leaving a stump attached to the ribs about 2 cm. in length. In making this division, place the finger between the muscle and the rib, pushing the loose fat and delicate veins away

from the muscle. The divided muscle usually requires three to four clamps to check small bleeding points. In making this dissection, one must use **great care** to avoid injury of a delicate plexus of veins running in the fascia over the intercostal muscles. The division of the pectoralis minor muscle being completed, this muscle and the vascular tissue passing in front of it and mentioned above now fall into the axilla, and from now on are treated as axillary contents to be removed in one piece.

Axillary Dissection (Figs. 535, 536, 537, 538).—The dissection can either be begun at the apex of the axilla (Fig. 536), or from below, beginning at a point opposite the divided pectoralis major tendon (Fig. 529). The latter is less difficult.



FIG. 532.—DIVISION OF PECTORALIS MINOR. (Sketch.)

The only object of the former is based on the theoretic reason of blocking the lymphatics. One will find, covering the brachial plexus, the large artery and vein, masses of fat and a network of minute vessels in a definite fascia. If this is nicked over the nerves, it can be torn and this mass of tissue brushed with a piece of gauze down over the vein. Seldom does a vessel require a ligature. One quickly acquires the technic of this manipulation. Now the axillary fat is grasped and pulled gently from the vein. This puts the branches under slight tension. With an artery clamp they can be separated, freed from fat, doubly clamped, and divided (see Fig. 535). When artery and vein lie close together, they should be separated and each clamped. The proximal vessel should at once be ligated: it is not a safe



FIG. 533.—DIVISION OF PECTORALIS MINOR.

Photograph from dissection of cadaver. This illustrates the division of the attachment to the coracoid process first. *x*, corresponds to Vessel I in Fig. 531; *a* and *b*, to clamps I and II in Fig. 531. *c*, axillary tissue.



FIG. 534.—DIVISION OF PECTORALIS MINOR FROM THE RIB.

Photograph from dissection of cadaver. *y*, stump of divided tendon of pectoralis minor; *x*, same as in Fig. 533; clamps also identical with those in Fig. 533.

procedure to leave clamps hanging on the axillary vein. In this manner one proceeds rapidly along the vein from below upward or from above downward. Except at the position of the acromiothoracic axis, all the vessels, arteries, and veins run downward and are easily separated, clamped, and ligated. The only difficult dissection is about this axis. One has already ligated a branch or two in separating the pectoral muscle from its clavicular bundle. This group of vessels is surrounded by considerable fat, which always contains lymphoid tissue and not infrequently metastatic glands. First, the vessels should be ligated close to the clavicular border of the greater pectoral muscle. This mass should be turned down over the artery. As a rule, the numerous distal vessels which have been

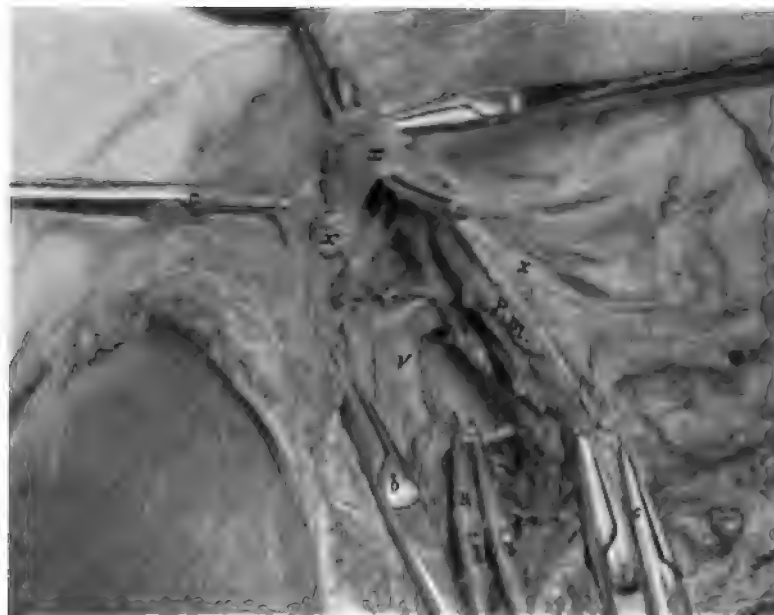


FIG. 535.—AXILLARY DISSECTION.

Method of separating branches of axillary vein, double clamping (*a*) preliminary to division and ligation; *v*, vein; *P. m.*, pectoralis minor, which has been divided; *x, x, x*, acromiothoracic vessels shown in Figs. 530, 531, 533, and 534; *c, c*, similar to clamps I and II in previous illustrations; *b*, clamp on tendon of pectoralis minor near coracoid process. Photograph from dissection of cadaver.

ligated are branches of the single artery given off by the axillary. The fat should be separated from the larger artery and this branch clamped and ligated. Then the mass is turned down over the vein and any venous branches ligated. I have frequently found that as many as fifteen clamps and ligatures were required to complete what may be called the acromiothoracic dissection. If the dissection has proceeded from below, when one reaches the apex of the axilla it is convenient to grasp the now free mass of axillary fat and pull it down and away from the vein. This facilitates the dissection of this delicate triangle. If one begins the dissection from the apex, it requires a little more time and patience to get all of the fat out of this triangle without injury to the axillary vein, and as this position is the most

serious for a vein injury, I would recommend that the operator begin the dissection of the axilla from below, until considerable experience has been acquired. The axillary vessels are now completely freed from their vascular attachment to the axillary contents. One now proceeds to separate the axillary tissue from the chest wall. This is most conveniently accomplished by grasping the axillary tissue,



FIG. 536. — AXILLARY DISSECTION FROM APEX OF AXILLA DOWN.

The dissection of the acromioclavicular vessels from the pectoralis major above has been completed. They are in the mass of fat above the exposed axillary vein. Clamps I and II, same as in previous illustrations; Clamp III, similar to a in Fig. 535.

pulling it from the chest wall, and making the separation with the gloved hand or a piece of gauze. Now and then a firm strand of connective tissue or a small vessel requires the knife. There is no objection to blunt dissection along the chest wall. This should be carried to the base of the axilla. There is now a mass of axillary tissue which has deep attachments only in the subscapular fossa (Fig. 539), that part of the axilla situated between the subscapular muscle and the chest.

Following the same plan of blunt dissection with the hand or gauze, this mass of fat is separated from the chest on one side and the subscapular muscle on the other. When it is freed, it is drawn out. Its apex is situated deep behind the axillary vessels. A clamp should be placed as high up as possible before the apex is severed and the mass reflected down and out toward the base of the axilla. As the separation is carried posteriorly from the apex down, a few more vessels between the



FIG. 537.—FURTHER DISSECTION DOWNWARD ALONG THE AXILLARY VEIN.

The acromiothoracic vessels have been divided from the artery and vein, and with their surrounding fat and lymphatics have been turned down toward the base of the axilla (Clamp IV), covering clamps I, II, and III as shown in Fig. 536. Clamp V is attached to the tissue removed from the apex of the axilla.

scapular muscles and the chest wall require clamping and ligature. The three difficult places in the axilla for a complete dissection are: the area about the acromiothoracic vessels, the apex of the axilla, and the apex of the subscapular fossa.

The Completion of the Operation (Fig. 540).—The axillary tissue is turned over against muscle and breast and dissected from the subscapular teres major and latissimus dorsi muscle. Large vessels pass between these muscles; the dissection here should be carefully done and the muscles should be cleaned of fat and fascia.

The dissection is then carried to the skin and the subcutaneous fat is cleansed from this skin which was situated over the axilla. In separating the completely dissected block of tissue from the skin which covered the axilla and was situated to the outer side of the breast, one is governed by the position of the tumor. If the disease is situated well within the inner hemisphere, make a large axillary flap; if in the



FIG. 538.—FURTHER DISSECTION ALONG THE AXILLARY VEIN.

To illustrate the separate double clamping of accompanying large venous and arterial branches. Clamp VI on venous branch; Clamp VII on arterial branch. Photograph from operation.

outer hemisphere or in the axillary border of the breast, the size of the axillary flap must be reduced to give the disease a good margin.

The Supraclavicular Dissection.—When this is indicated by the inspection of the axillary metastasis (already discussed), the skin incision already made to the clavicle is extended upward until it meets the sternocleidomastoid muscle at the position a little above the omohyoid. The skin and subcutaneous fat are dissected back until there is exposed a triangular space bounded by the

sternocleidomastoid muscle, the clavicle, and the base of the outer skin flap which crosses the clavicle at about the junction of the middle and outer third. One now makes a triangle of the deeper tissues, cutting the fascia and stripping it back and down along the outer border of the sternomastoid, and then along the clavicle. The internal jugular vein is exposed from above downward. In the upper portion the omohyoid belly is met and divided, one portion being retracted over the sternomastoid, the other outward. These make good retractors and limit the upward



FIG. 529.—DISSECTION OF SUBSCAPULAR FOSSA.

Clamp VIII is attached to this tissue, which lies between the chest wall and the subscapular muscle. Photograph from operation.

extension of the dissection. All the tissue is freed from the internal jugular vein down to the clavicle. Then the dissection is made from this point out along the clavicle. One quickly encounters the external jugular, which is clamped, cut, and ligated. This triangular piece of tissue, the apex of which was situated between the internal jugular and subclavian, is reflected outward and stripped from the muscles forming the base of this triangle. Quite a few veins and arteries are encountered, but they are easily recognized by placing tension on this triangular flap of tissue. The dissection is carried until the levator scapulæ muscle is reached.

This corresponds to the base of the already reflected outer skin flap. The base of this triangular mass of tissue is now divided, better from above downward. It is always very vascular.

Closure of the Wound.—For that portion of the wound in which contiguous skin flaps can be approximated any method of suture may be employed. The open wound is reduced in size by a purse-string suture of silver wire. I am quite confident that silver is the suture of choice here. During the skin suture an assistant should be cutting grafts from the opposite thigh, which can be prepared before



FIG. 540.—SKETCH OF THE COMPLETED DISSECTION.
There only remains the division of the skin of the axillary flap.

operation, or very easily during the latter part of the operation. The large grafts are spread on rubber tissue, raw surface up. This prevents them from curling. They are placed on the wound and the rubber tissue gently pulled off. In the majority of cases the entire defect is covered and the graft should overlap the skin edge. In a few cases, when the patients are very fat and there is more oozing than usual, one should leave the zone of raw tissue between the skin edge and the graft, otherwise the wound secretion will collect under the grafts, preventing organization.

Drainage.—In my own practice I do not drain these wounds. If one is very

careful in hemostasis it is unnecessary. Quite a number of surgeons, however, prefer to drain the axilla through a stab incision made in the base of the axillary flap.

Dressing.—The raw surface on the thigh is covered with a piece of protective smeared with sterilized boric vaselin ointment, and this protective is held in place by adhesive straps. This is covered with a roll of sterile gauze and a bandage. The breast wounds, both approximated skin and skin grafts, are covered with silver foil and paper, and this in turn covered with loose gauze. The most important point in the dressing is the packing of the axilla. The arm should be placed at an angle of about forty-five degrees to the body, and this space filled with gauze. The bandage should include the arm with the body. The padding between the arm and the body is held in place by turns over both shoulders, taking in the base of the packing between the elbow and the body. If the neck operation has been done,

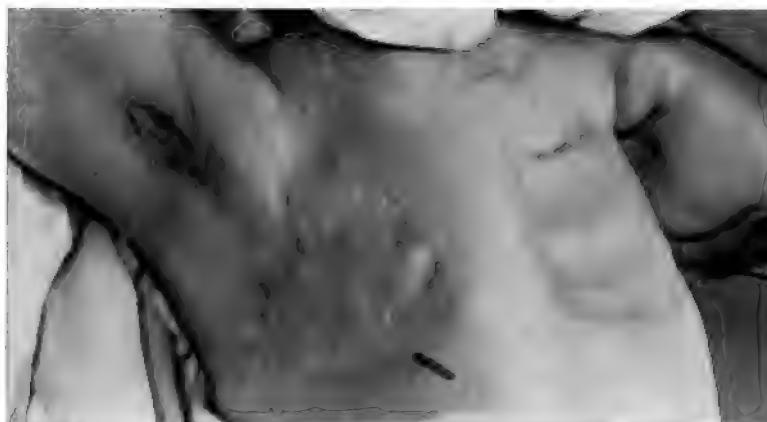


FIG. 541.—ULTIMATE RESULT AFTER BILATERAL OPERATION.
Eighteen months after operation on right side and six months after operation on left side. (This patient has been permanently cured.) Halsted's clinic.

it should be covered with loose gauze and included in the shoulder bandage with additional turns around the neck. The entire dressing should be fixed with crinoline or plaster bandage, and the forearm supported by a sling. The dissection of the axillary flap (Fig. 535) and its proper packing with external gauze to preserve the fornix, and the fixation of the arm in marked abduction, are the most important measures in the technic of the operation to prevent future restricted motion of the arm.

In some cases in which the tumor is situated in the axillary quadrant of the breast so much of the axillary flap must be sacrificed to give the tumor a wide berth that it becomes necessary to make a large flap of what is left of the axillary flap by a transverse incision from the junction of the axillary flap to the skin at the lower and outer quadrant posterior over the chest wall. This has been required in about 4 per cent. of the cases.

Plastic Operations on Muscle and Skin.—In the experience of Halsted's clinic the functional use of the arm after operation has been so uniformly good (Figs. 541 and 542) that I fail to see the justification of various plastic procedures. Crile¹ divides and later sutures the pectoralis minor muscle. This procedure was also employed a number of years ago by Halsted. I have examined these cases carefully, and was unable to demonstrate any improved function. I agree with Halsted that this procedure has an element of danger, in that cancerous tissue might be left in the muscle. The same arguments, I believe, apply against the plastic method on both muscles, advocated by Murphy.² Even granting that this plastic measure does add somewhat to the future function of the arm, I believe the risks of an incomplete dissection of the axilla too great to justify it. A number of surgeons employ some method of plastic incisions to facilitate the complete closure of the skin defect. There are no objections to such methods if the area of skin removed with the breast is not reduced in size. Warren's method³ impresses me as one of the best. I have had no experience with any of these modifications and I have no reason to regret skin grafting, which appeals to me as simpler and quicker. Payr's⁴ method of dislocating the opposite breast does not appeal to me.

Accidents During Operation.—If the dissection is performed carefully and bloodlessly, accidents should not happen. Richard R. Smith⁵ has collected the injuries to axillary vessels during operations for carcinoma of the breast. If the axillary vein is torn, lateral ligation or suture is not at all difficult; even ligation of the vein, if necessary, is not followed by any bad effects.

After-treatment.—A subcutaneous infusion of salt solution can be given under the opposite breast, if indicated, before the dressing is applied. This is seldom necessary. When the patient reaches the ward, it is a good routine plan to give an enema of salt solution every four or six hours for twenty-four hours. Feeding by mouth can be begun as soon as the post-operative nausea will permit. These patients are usually on soft diet at the end of forty-eight hours and ordinary diet on the fourth day. The patient's head and shoulders can be supported by pillows as



FIG. 542.—ULTIMATE RESULT TEN YEARS AFTER OPERATION.

Healing by granulation; no skin-grafting. Halsted's clinic.

¹ Crile: Ohio State Med. Jour., Oct., 1905.

² Murphy: "Surgery, Gynecology, and Obstetrics," Jan., 1906, ii, 84.

³ Warren: Annals of Surgery, Dec., 1904.

⁴ Payr: Deutsche Zeitschr. f. Chir., 1906, lxxxi, 361.

⁵ Smith, Richard R.: Annals of Surgery, May, 1904.

CHAPTER XXXII.

OPERATIONS UPON THE GALL-BLADDER, BILE-DUCTS, AND LIVER.

By ALBERT J. OCHSNER, M.D.

HISTORY.

The gross pathology of liver abscess, echinococcus cyst, dropsy of the gall-bladder, and obstructive jaundice, together with the essential features of the symptomatology of these affections, has been well known for centuries. It is therefore not surprising to find suggestions as to the possibility of operative interference, and even attempts at the operations themselves, being made long before the introduction of anesthesia and antiseptics made it technically possible for the surgeon to undertake successfully such operative procedures.

In accordance with the surgery of their time we find the older surgeons, from the time of Hippocrates until the modern surgical era, confining themselves chiefly to the simple incision or puncture of those liver or gall-bladder abscesses which already of themselves gave indications of opening on the surface. Thus Morgagni¹ in 1761 says: "It does not escape me, however, that before the swelling occupies all the muscles which lie before the cyst, causes considerable suppuration on all sides, and the pus forms winding sinuses for itself, . . . the case must, of course, turn out more successfully for those who open by incision the cyst which has not coalesced with the peritoneum." In spite of this clear conception of the benefits to be derived through surgical drainage, Morgagni states that he himself prefers to wait "till time shall confirm its advantages and remove all doubts, dangers, and difficulties by many repeated experiments."

Jean Louis Petit,² as early as 1733, fully described the operation of cholecystotomy, essentially as it is now done, and actually advocated the operation as a deliberate therapeutic procedure. In support of his views Petit quotes four cases, the majority operated on for a supposed abscess. Two of these cases died and two recovered, one of them with a fistula through which a calculus was removed at a later date.

Obviously, the technical difficulties of such an operation as Petit advocated were too great to be successfully overcome by the surgery of this period, and it is not until after the introduction of anesthesia that we find the operations again seriously considered.

¹ Morgagni, Joannes Baptista: "De Sedibus et Causis morborum," etc., 1761, Bk. iii, Letter xxxvi, Art. 52.

² Petit, Jean Louis: *Memoires de l'Acad. roy. de Chir.*, 1743, i, 255. (Paper originally read in 1773.) *Maladies Chirurgicales*, 1790, i, 282.

In 1859 Thudichum¹ suggested an operation for the extraction of these foreign bodies by establishing a biliary fistula and crushing the stone. As a possible procedure, he proposed to open the abdomen, seize the gall-bladder, fasten it to the abdominal wall, and, after adhesions had formed, to open it.

Although the earlier literature on the subject shows, it is true, that the operation of cholecystotomy had been discussed and practised before Sims' operation, it must, nevertheless, be conceded that to him is due the credit of placing it on a new basis as a deliberate operation in the surgery of the abdomen.

Sims² performed his operation April 18, 1878, and that he fully comprehended the essential surgical possibilities not only of cholelithiasis but also of liver abscess and hydatid cyst there can be no doubt. He expresses as his conviction that: "The great lesson this case teaches is this: In dropsy of the gall-bladder, in hydatid tumors of the liver, in suspected abscess of the liver, and in gall-stones we should not wait until the patient's strength is exhausted, or till the blood becomes bile-poisoned, producing hemorrhages, but we should make an early incision, ascertain the true nature of the disease, and then carry out the surgical treatment that the necessities of the case demand."

First to follow the lead of Sims was W. W. Keen,³ of Philadelphia, to whom is due the credit of the first cholecystotomy performed in this country.

Lawson Tait⁴ in 1879 performed the first successful operation of cholecystotomy, and to Tait more than to any other surgeon of this period is due the credit of placing the surgery of the liver and gall-bladder on a firm basis. Developing a technic essentially similar to that followed by the leading surgeons to-day, Tait was able in 1889 to report a series of fifty-five cases of cholecystotomy with but three deaths, all of these deaths occurring at late periods following the operation and not in any way referable to the operation itself.

In addition to these remarkable achievements in gall-bladder surgery Tait was also able at this time to report seventeen cases of hepatotomy with but two deaths, the series comprising ten cases of hydatid cysts, two cases of "cysts," two liver abscesses, two cases of gall-stones in the liver, and one case of "tumor."

Following the work of these pioneers, the development of this phase of surgery has been largely along the line of improvements in technic and the development of special operative procedures applicable to different types of lesions.

Cholecystectomy was first performed by C. Langenbuch⁵ in 1882, although it is

¹ Thudichum, J. L. W.: "Pathology and Treatment of Gall-stones," *Brit. Med. Jour.*, Nov. 19, 1859, 935.

² Sims, J. Marion: "Remarks on Cholecystotomy in Dropsy of the Gall-bladder," *Brit. Med. Jour.*, June 8, 1878, 811. "Cholecystotomie pour l'hydropsie de la vesicule biliaire," *Rev. de Litt. Méd. Paris*, 1878, iii, 564; 1879, iv, 34, 78, 107, 250, 278, 400.

³ Keen, W. W.: "A Case of Cholecystotomy, with Remarks," *Amer. Jour. Med. Sci.*, 1879, lxxvii, 134.

⁴ Tait, Lawson: "The Surgery of the Liver," *Edinburgh Med. Jour.*, 1889, xxxv, 305, 407.

⁵ Langenbuch, C.: "Ein Fall von Extirpation der Gallenblase wegen chronischer Cholelithiasis: Heilung," *Berlin. klin. Wochenschr.*, 1882, xix, 725.

said that as early as 1826 Campaignac¹ endeavored in vain to prevail upon the surgeons of his day to take up the operation.

The operation of cholecystenterostomy was advocated by Gaston² in 1884, and afterward perfected by the introduction of the Murphy button. Choledochotomy, conceived by Langenbuch in 1884, was first typically performed by Courvoisier,³ in 1889.

The work of Kocher, Kehr, Parkes, Mayo-Robson, Fenger, Riedel, and others has done much toward the development of this field of surgery.

ETIOLOGY OF GALL-STONES AND DISEASES OF THE BLADDER AND BILE-DUCTS.

In considering the etiology of gall-bladder disease it is important to bear in mind its anatomic relation and its mechanical provisions. So long as its anatomic relations are normal, and the organ is, mechanically considered, approximately perfect, there is no occasion for treatment, because the gall-bladder becomes distended with bile, which is a non-irritating fluid, and empties itself regularly. These functions give rise to neither pain, irritation, nor discomfort.

Normally, the gall-bladder is suspended from the under surface of the liver as a very slightly distended, pyriform sac which empties its fluid rapidly into the duodenum. The muscles of the gall-bladder are very active and well able to empty its contents.

It seems to have been proved beyond a doubt that this pouch shares the fate of all similarly constructed organs in the body—the stomach, the urinary bladder, the pelvis of the kidney, the vermiform appendix. So long as there is nothing to prevent them from emptying their contents they are almost certain to remain normal, but as soon as an obstruction occurs which interferes with the natural emptying of the organ, trouble is likely to ensue. In other words, an interference with drainage is sure to cause a certain amount of residual substance which favors the accumulation of bacteria and injury to the lining of the gall-bladder.

In health it is probable that in the majority of cases the bile is sterile. Cushing⁴ states that the bile itself, contrary to the wide-spread belief in its antiseptic properties, is a good culture-medium for most organisms. It is surprising that the bile should ordinarily be sterile, as Gilbert has demonstrated, if the probability that microorganisms are frequently being passed out with it from the liver is considered.

The bile remains sterile, however, only so long as it flows unobstructed through the ducts. It has been shown experimentally that as soon as the outward flow

¹ Campaignac: Cited by Geo. Ryerson Fowler. "Historical and Critical Observations upon the Surgery of the Liver and Biliary Passages," Brooklyn Med. Jour., 1900, xiv, 932.

² Gaston, James McFadden: "Experimental Cholecystotomy," Atlanta Med. and Surg. Jour., 1884, xxiii, 336, 385.

³ Courvoisier, L. G.: "Pathologie und Chirurgie den Gallenwege," Leipzig, 1890.

⁴ Cushing, Harvey: "Observation upon the Origin of Gall-bladder Infections and upon the Experimental Formation of Gall-stones," Johns Hopkins Hosp. Bull., 1899, x, Nos. 101, 102, p. 166.

of bile has been obstructed by ligation of the common duct, the bile above the obstruction becomes infected. Bacteria may enter the gall-bladder in two ways: (1) Along the common duct from the duodenum. (2) By the blood-current, chiefly through the portal vein. The fact that the bacillus coli is the most common bacterial inhabitant of the gall-bladder and of gall-stones suggests that an intestinal origin is most frequent.

The injury which results from the accumulation of bile in the gall-bladder may be simply catarrhal at first, but will later become destructive to the mucous membrane and give rise to ulceration; the latter in turn will result in cicatricial contraction and further obstruction. In this way the condition becomes progressive.

If, in the mean time, the mucus and débris in the gall-bladder have been molded into gall-stones, the lining of the gall-bladder is not only in contact with the relatively non-irritating bile, but also with these hard bodies, which are of a very irregular form.

Clinical experience has shown the correctness of this theory, for in most of our cases there has been a distinct interference with the natural drainage of the gall-bladder. In many cases this was caused by a displacement downward of the viscus by adhesions to the omentum or the transverse colon or both. In other cases the gall-bladder was pedunculated; such a condition has been attributed to the effects of tight lacing, and as in many cases it occurs only in women, the view is probably correct.

Bacteria, especially the colon bacillus, are present with great regularity in diseased gall-bladders and in gall-stones. It has been found that a large proportion of gall-stone patients have suffered previously from typhoid fever. More than 35 per cent. of my cases have suffered from acute or chronic appendicitis. It is difficult to say sometimes whether typhoid fever, cholecystitis, and appendicitis are not simply simultaneous infections, or whether the infection of the gall-bladder is secondary to the other infections.

In experiments upon animals it has been found that simple infection of the gall-bladder gives rise to no pathologic condition, provided there is no obstruction to the biliary or the cystic duct. The constant flow of new bile seems to be sufficient to dilute and wash away the infectious material to a sufficient extent to make the infection harmless.

It is quite different so soon as there is an obstruction to the ducts. When there is residual bile in which microorganisms can multiply, a pathologic condition will ensue which may develop simply into a catarrhal inflammation of the mucous lining of the gall-bladder, or it may result in the formation of gall-stones or in a severe inflammation of the gall-bladder involving anatomic structures beyond the mucous membrane. In man this obstruction may result from the inflammation of the mucous membrane of the common duct due to an infection from the alimentary canal, or, as I have seen in a number of cases, the gall-bladder may be drawn downward by adhesions, causing a short bend in the common duct, or more usually in the cystic duct, or by an adhesion between the duodenum, stomach, and

liver. This condition is often due to a gastric ulcer. Again, the gall-bladder may be forced down out of its normal position on account of tight lacing, and the mucus and débris, accumulating in the pouch containing residual bile, may be expelled at intervals and may clog the biliary or the common duct, and thus form the obstruction necessary to make the infectious material effective. I have repeatedly observed a complete obstruction of the common duct produced in such a manner. Moreover, I have observed some of the most violent paroxysms of gall-stone colic in cases of this kind.

If the obstruction persists in the presence of infectious material in the gall-bladder, a suppurative inflammation may ensue, resulting in an empyema of the gall-bladder; if the infection is severe, especially if there be present a spasmodic contraction of the gall-bladder, the entire mucous lining of the latter may become gangrenous, as I have repeatedly observed in acute cases.

The condition may in turn extend to the other layers of the gall-bladder, resulting in a gangrene of the entire organ, or it may affect only a small portion of the gall-bladder. When the latter is true, the contraction of the non-affected part of the gall-bladder is likely to cause a perforation at the gangrenous point.

It is of practical importance to know that these spasmodic contractions of the gall-bladder correspond with contractions of the stomach, and that they will subside when the stomach is at rest, only to recur when this condition of rest in the stomach is interrupted.

Age and sex undoubtedly have some influence upon the formation of gall-stones. Hartmann¹ found the average age of his male patients who earned their living by manual labor to be at the time of operation forty years, and the period of duration of symptoms to be six years. Of the leisure class, the average age was thirty-seven, and the period of duration of symptoms was nine years. In women of the working-class the average age was thirty-five and a half and the duration of symptoms seven years; of the better class, the age was thirty-seven and the duration of symptoms nine years. The time of the onset of stone was, therefore, in all cases before the age of thirty-five.

Moynihan² found in fifty cases that the average age of the patient was forty-five years, and the duration of symptoms five and one-half years, making the time of onset on the average about forty years.

In looking over a series of fifty of my own cases, it was found that the average age at the time of operation was forty-six years and the average duration of symptoms was six and one-half years. In this same series of cases there were four times as many females as males.

Gall-stones have been observed in the new-born. Still³ reported three cases of gall-stones in infants. In one child, female, aged nine months, whose symptoms

¹ Hartmann, O.: "Bakteriologische Studien an der Hand von 46 Gallenstein-operationen nebst einem Beitrag über ätiologische Fragen des lithogenen Katarrhs der Gallenblase," *Deutsche Zeit. f. Chir.*, 1903, lxxviii, 230.

² Moynihan, B. G. A.: "Gall-stones and their Surgical Treatment," Phila., 1905, p. 53.

³ Still, Geo. F.: "Biliary Calculi in Children," *Trans. Path. Soc. of London*, 1899, 1, 151.

were vomiting and wasting, there were purpuric patches but no jaundice. Autopsy showed the gall-bladder filled with golden-yellow bile containing eleven small calculi. The second child, female, aged eight months, died of acute miliary tuberculosis. The gall-bladder was found to contain golden-yellow bile, mucus, and small calculi. The third child, male, aged five months, died from marasmus and bronchopneumonia. The gall-bladder contained rather dark bile and three calculi.

SYMPTOMS AND SIGNS OF GALL-BLADDER DISEASE.

The frequency with which gall-stones are overlooked draws our attention to the fact that it will be necessary to change the basis of our diagnosis, because the old plan must continue to result in wrong conclusions.

In studying the histories of a series of gall-stone cases it will be found that the early manifestation of the presence of gall-stones will practically never be referred by the patient to the region of the gall-bladder or bile-ducts. The patients refer their trouble to the region of the stomach and not to the liver. Perhaps the earliest symptom, which has persisted for years, is "indigestion." It is not uncommon for these patients to come to the surgeon with a diagnosis of an attack of indigestion, gastric catarrh, neuralgia of the stomach, spasms, etc.

The symptoms, complications, and danger of gall-stones differ greatly according to the location of the stones in the gall-bladder, cystic or common ducts. Gall-stones in the gall-bladder in the absence of infection may produce so little discomfort that they may persist for years without being discovered. As soon as catarrh or some acute infection occurs, or the stone passes from the gall-bladder into the cystic duct, there may be a great variety of symptoms, varying from mere spasms, frequently called attacks of indigestion, to very severe colic, agonizing in character, so severe as even to lead to collapse.

Pain—to be distinguished from colic—may be local or referred. The local pain may be dull in character, rather diffuse, and exaggerated upon taking food. It is this variety of pain which is apt to be mistaken for that due to disease of the stomach. The dull pain is usually due to some irritation or inflammation; the gall-bladder becoming more or less tense by some obstruction of the cystic duct interfering with the free exit of bile, perhaps due to an impaction of a stone in the cystic duct. Tenderness in these cases is not always found except on deep pressure in the region of the gall-bladder.

Murphy¹ writes: "The most characteristic and constant sign of gall-bladder hypersensitiveness is the inability of the patient to take a deep inspiration when the physician's fingers are hooked up deep beneath the right costal arch below the hepatic margin. The diaphragm forces the liver down until the sensitive gall-bladder reaches the examining fingers, when the inspiration suddenly ceases as though it had been shut off. I have never found this sign absent in a case of calculus or in infectious cases of gall-bladder or duct disease."

¹ Murphy, J. B.: "The Diagnosis of Gall-stones," *Med. News*, vol. i, 1903, p. 85.

The pain is frequently more acute than that described above, which means that there is a more marked irritation and inflammation of the gall-bladder or the bile-ducts, and perhaps of the surrounding peritoneum.

The pain may be referred to various regions. It frequently radiates to the right subscapular region and occasionally to the left; to the epigastric region or umbilicus; to the front of the chest and neck or down the arm.

Boas¹ writes: "Least recognized as a symptom of cholelithiasis is tenderness over the posterior surface of the liver." To demonstrate it the finger should be pressed against a point to the right of the tenth dorsal spine; then against successive points in lines running horizontally outward, opposite the other spinous processes. It will then be evident which side, if either, is the more tender.

Colic in gall-stone disease is not as common as formerly supposed. I have found that over one-half of my cases have never experienced severe biliary colic.

The colic, when severe, causes the most intense suffering. It causes a sudden severe pain and not infrequently produces a condition of collapse. The patient is cold and yet has profuse sweating. The location of the pain differs greatly. When a colic is due to a spasm of the gall-bladder or cystic duct, it is most apt to begin along the right costal margin and radiate to the right subscapular region. When due to spasms of the common duct, it is more apt to be located centrally and radiate to the midscapular region. It may be epigastric throughout or may even be situated in the left upper quadrant of the abdomen.

The cause of gall-stone colic has been much discussed, yet there seems to be no agreement upon this subject.

Kehr² and other authors take the view that the colics are due to an inflammatory response to irritation in the gall-bladder or in its ducts.

Considering the abruptness with which these colics begin, and the suddenness of their relief, it would seem more probable that the pain was due to a spasm of the gall-bladder or its ducts during the attempt at the expulsion of a calculus or of thick bile, sand, or mucus. This suddenness with which the pain begins and subsides is certainly incompatible with anything of an inflammatory nature, and can only be explained by a spasm due to the sudden entrance and exit of some foreign body, but the presence of inflammation naturally increases the obstruction and the pain.

It is of practical interest to know that these spasmodic contractions of the gall-bladder correspond with the contraction of the stomach, and that they subside when the stomach contraction is interrupted.

I have repeatedly observed that attacks of gall-stone colic which would not subside from the use of as much as one-half to three-fourths of a grain of morphin given hypodermically, would stop directly upon irrigating the stomach with very hot water, thus putting the stomach at rest, only to recur the moment any form of

¹ Boas, J.: "Beiträge zur Kenntniss des Cholelithiasis." Münch. med. Wochenschr., 1902, No. 15, xlix, 604.

² Kehr, Hans: "A Review of 720 Laparotomies for Gall-stones, with a Consideration of 90 Cases of Drainage of the Hepatic Duct." Münch. med. Wochenschr., 1902, xlix, No. 41, 42, 43, S. 1688, 1748, 1800.

food was taken into the stomach, giving rise to the normal contraction of this organ. In these cases the renewed use of gastric lavage and further abstaining from food would result in permanent interruption of the spasmodic contraction of the gall-bladder, and would permanently stop the gall-stone colic.

This point is of practical importance, because it not only indicates an efficient means for securing the relief of pain, but also one for preventing destruction of gall-bladder tissue and possible perforation.

Stomach Symptoms.—Perhaps the most common symptom of gall-stone disease is "indigestion." The attacks of indigestion begin with pain in the epigastrium, followed by nausea and finally by vomiting, which usually brings relief. The nausea and vomiting are partly reflex in origin and partly due to direct irritation of the stomach.

Other gastric disturbances associated with gall-bladder disease are frequently manifested by distress in the epigastric region, described as a feeling of weight or a burning sensation after eating; also gaseous distention of the abdomen. The subjects of gall-stone disease are also usually troubled with eructations of gas after eating.

It is not uncommon for these patients to have repeated attacks of nausea and vomiting and attacks of indigestion accompanied by severe pain in the epigastrium, often called gastralgia or neuralgia of the stomach. After an attack of nausea and vomiting and epigastric pain there is apt to be an interim when the patient is free from stomach symptoms or has only the milder symptoms of bloating and distress after eating.

There may be a dull pain, beginning in the epigastric region and extending around the right side at about the level of the tenth rib, passing to a point near the spine and progressing upward underneath the right shoulder-blade.

Jaundice.—Jaundice, upon which so much stress has been placed in the diagnosis of gall-stones, is absent in the greater number of cases at the time they consult the surgeon. My experience has been that only a small proportion of our cases have ever been severely jaundiced, and in more than one-half of them jaundice has never been observed.

Mayo¹ says: "Jaundice has no part in the diagnosis of gall-bladder stone, and when present means a complication." Kehr² states that, in his experience, jaundice is absent in from 80 to 90 per cent. of gall-stone cases, and even in choledocholithiasis—those cases in which the stones are lodged in the choledochus and hepaticus—the jaundice is absent in 33½ per cent. He further states that the passage of stones without a concomitant jaundice is not at all uncommon. Deaver³ states that jaundice is absent in the majority of gall-stone cases.

The fallacy in regard to icterus in connection with gall-stones has been handed

¹ Mayo, Wm. J. and Charles H.: "The Diagnosis of Gall-stone Disease," St. Paul Med. Jour., 1905, vii, 79.

² Loc. cit.

³ Deaver, John B.: "The Significance of Jaundice as a Symptom in Disease of the Biliary Tracts," N. Y. Med. Jour., 1903, lxxviii, 301.

down to successive generations of physicians and the laity so long that the majority of patients refuse to believe that they can have gall-stones and not be jaundiced. Jaundice in cholelithiasis is due to an impaction of a stone in the common or hepatic ducts, or to an infection of these ducts, and occasionally to an impaction of a large stone in the cystic duct pressing upon the common or hepatic ducts. When jaundice is due to gall-stones, it is most always preceded by a colic. The colic may come on a few hours or days before the appearance of jaundice. The yellow tinge, as a rule, comes on gradually and increases until the obstruction is relieved, and then gradually disappears.

Remittent icterus, according to Fenger,¹ slight, or, as it might be called, incomplete attacks of icterus, occurring as often as once or twice a week, is characteristic of stone in the common duct, and, in his opinion, of floating choledochus stone. Fenger describes this condition as occurring in the following manner: A stone becomes impacted in the common duct, and the accumulation of bile on the proximal or liver side presses the walls of the duct away from the stone, allowing the bile to pass around the stone. Following this, the jaundice is due to a "ball-valve" action of the stone.

When jaundice is due to carcinoma involving the gall-ducts, or results from pressure from a growth of the head of the pancreas, the jaundice will appear gradually and without pain. There will be no remission or intermission, but the color will steadily deepen from day to day until the skin becomes a greenish-yellow color. It is very rare to meet with jaundice of a deep greenish-yellow color, except in the presence of malignant disease.

Fever.—Fever is not ordinarily present early in a simple attack of gall-stones. If the attack is prolonged and infection occurs, fever develops. When the infection is confined entirely to the gall-bladder, the rise of temperature is usually not high. Mayo explains this condition as being due to the fact that there are few lymphatic channels in the gall-bladder and consequently slow absorption.

When there is an infection of the ducts there may be rigor accompanying or following the colic, with a very abrupt rise of temperature to its maximum, and then with almost equal rapidity a return to normal. These attacks may simulate a malarial infection. Between the attacks of infection the temperature remains practically normal. Persistent fever associated with other gall-stone symptoms may mean an empyema or severe cholecystitis as an extension of the infection to the channels of the liver.

Moynihan² speaks of a temperature chart, showing these attacks of infection represented by an abrupt, peak-like elevation with the normal interspace as most characteristic. He calls it a "steeple" chart, and further states that the occurrence of these angular elevations in the chart recording the temperature is quite pathognomonic of gall-stone disease.

¹ Fenger, Christian: "Stones in the Common Duct and their Surgical Treatment," *Amer. Jour. Med. Sci.*, 1896, cxi, 125, 286.

² Moynihan, B. G. A.: "Gall-stones and their Surgical Treatment," 1905, p. 133.

Murphy¹ speaks of the "temperature angle of cholangic infections." He writes: "The temperature in an hour will rise to 104° or 105°, remain stationary for a few hours, and then drop as suddenly to normal, and remain normal for hours, days, or even weeks, when it will go through the same rapid variation, and continue to repeat itself at irregular intervals." And again: "These temperature changes are so characteristic that I have given them the name of the temperature angle of cholangic infection."

Tumors.—A palpable enlargement of the gall-bladder occurs as the result of some obstruction of the cystic duct. This obstruction may be from an impacted stone, a cicatricial contraction of the cystic duct, or a twist of the neck of the gall-bladder, or from an abnormal growth. It occurs also when there is an obstruction of the common duct caused by some pressure from outside of the duct.

An enlarged gall-bladder is generally pear-shaped, lies just below the edge of the liver, and moves up and down during the act of respiration with the liver.

Enlargement of the liver is not a constant sign, and is rarely present as long as the disease is confined to the gall-bladder and the cystic duct.

Special Symptoms.—*Obstruction of Cystic Duct.*—Obstruction of the cystic duct causes retention of fluid in the gall-bladder, with a rapid distention of the gall-bladder behind the obstruction. This fluid consists of mucus if the infection is slight, or of mucopus if the infection is more severe. The bile that may be in the gall-bladder at the time the obstruction occurs is rapidly absorbed, leaving either the clear mucus or turbid fluid, according to the amount of infection. The distended gall-bladder may reach an enormous size and usually becomes palpable. If the inflammatory process be very acute, a severe cholecystitis or even gangrene of the gall-bladder may result. Associated with this condition a local protective peritonitis usually develops, leading to the formation of visceral adhesions.

The early symptoms of impaction of stone in the cystic duct are usually very acute, beginning with a severe colic underneath the right costal arch, and radiating up into the right subscapular region. There is rarely any jaundice accompanying or following the pain. The pain loses its colicky character rather early, and there may be only a dull ache or sense of discomfort. If the obstruction becomes chronic and there is little or no infection, a hydrops of the gall-bladder develops. If it is associated with infection of any severity, an empyema of the gall-bladder is apt to be the result. All of these symptoms may occur without any evidence of jaundice.

Rarely a stone in the cystic duct may be so large as to press upon the common duct and cause jaundice. Robson² states that in rare cases a stone impacted in the cystic duct may, by pressure on the common duct and on the portal vein, cause both jaundice and ascites and thus may lead to an error in diagnosis.

I have seen a case in which the gall-bladder was adherent to the anterior abdominal wall an inch below the umbilicus. There was a perforation of the abdomi-

¹ Murphy, J. B.: "The Diagnosis of Gall-stones." *Med. News*, 1903, lxxxii, 830.

² Robson, A. W. Mayo: "Common Duct Cholelithiasis: Its Symptoms, Complications, and Treatment," *Surg. Gynec. and Obstet.*, 1906, ii, 1.

nal wall at the point, half an inch in diameter, communicating with the hernial cavity underneath the deep fascia, one and one-half inches in diameter, which contained seven stones and a quantity of pus and granulation tissue. I have seen two other similar cases and one gall-bladder which had perforated into the stomach, and others which have perforated into other portions of the alimentary canal have been described by different observers.

I have found a gall-stone in the ileum one and one-half inches in diameter which, of course, must have entered this viscus by ulceration, as it was too large to pass through the cystic or common ducts. The operation was performed for the relief of an acute intestinal obstruction, and the patient's condition was too serious to permit of the necessary manipulation to locate the point of perforation.

Acute Cholecystitis.—The symptoms found in an acute cholecystitis are similar to those present in the early stage of cholelithiasis. In addition to these, there is an enlargement of the gall-bladder, making it palpable and very tender upon pressure. There is often acute severe pain in the gall-bladder, which may radiate to the back, chest, or abdomen. Associated with the pain and tenderness there may be a right-sided rigidity which may simulate appendicitis. The history will help us in the diagnosis, as it will be found that the pain was originally in the gall-bladder region and later became diffused. As a rule, the pain, tenderness, and rigidity of the abdomen are limited to an area along the costal margin.

Moynihan¹ states that the catarrhal form, and indeed the other forms, may arise in the absence of gall-stones, but in the majority of instances it is the damage done by a calculus that opens the path to infection.

Chronic Cholecystitis.—In chronic cholecystitis there is seldom present a definite train of symptoms which would ordinarily direct one's attention to the gall-bladder. However, there is usually present a rather constant, dull, aching pain in the right hypochondrium, often hardly noticeable. There may be exacerbations of the inflammatory trouble, when the pain will be more marked. The principal symptom will be in the line of digestive disturbances, manifested by a sensation of fullness in the epigastrium, more or less bloating and distress coming on during or immediately after eating, accompanied by eructations of gas. It is not uncommon for these patients to complain of sour stomach.

Occasionally these patients will suffer from a typical attack of biliary colic from the passage of sand-like material through the gall-ducts. It is not uncommon in cases of chronic cholecystitis to find the gall-bladder filled with black, thick, sandy bile.

The diagnosis depends upon the various gastric disturbances enumerated above, together with the dull aching or burning pain in the right hypochondrium, and the finding of an area of tenderness in the region of the gall-bladder. This tenderness is practically always present, and can be elicited by placing the finger-tips underneath the costal arch, and, when the abdominal muscles are relaxed, having the patient take a deep, full inspiration, forcing the gall-bladder against the finger-tips.

¹ Loc. cit.

Stones in the Common Duct.—The presence of stones in the common duct has been variously estimated. In 1500 operations upon the gall-bladder and bile-passages, Mayo¹ met with 207 cases of common-duct stone.

Kehr,² in 720 operations for gall-stones, had 137 common-duct cases.

Mayo Robson³ says: "In my hospital practice I find that my common-duct cases bore the proportion of one-third to the whole of my operations."

In common-duct cases it is not uncommon to find a history of frequent attacks of pain which have occurred at variable intervals for years, accompanied by a slight jaundice. Suddenly there will be an attack of severe pain with a rapid and pronounced jaundice. This is the time at which the stone passes into the common duct. If the stone be a small one, it may pass on into the intestines and the jaundice entirely clear up in a few days. If the stone becomes impacted in the common duct, there will be a complete obstruction of the passage of bile, resulting in severe jaundice and enlargement of the liver.

It is rare to meet with an acute permanent occlusion of the common duct from stone. As soon as the stone becomes impacted, the pressure of the bile causes a dilatation of the duct, so that a stone, which at first fits tightly, will be loose in the duct, allowing the bile to pass around it. We then may have a condition which Fenger describes, in which the stone acts as a "ball-valve" in the duct.

With a stone in the common duct it is questionable whether the jaundice ever entirely disappears. There may be intervals when the patient does not notice any icterus, but upon close examination the conjunctiva will always show it.

Mayo⁴ has found that 33½ per cent. of his common-duct cases have no perceptible jaundice at the time of operation.

With a stone floating in the common duct as a "ball-valve" there will be intermittent attacks of pain with jaundice of a varying degree. These attacks are usually accompanied by chills, with a sudden rise in temperature, which is apt to assume a quite characteristic malarial curve. During and after these attacks there are tenderness and enlargement of the liver.

One important symptom in obstruction of the common duct is the rapid and considerable loss in weight. Fenger⁵ ascribed this loss of weight to intermittent, frequent ptomain intoxication,—that is, bile absorption,—as well as to the disturbed digestion.

It is important to bear this point in mind as a symptom of stone in the common duct. The loss of weight is very apt to suggest a diagnosis of malignant disease.

¹ Mayo, Wm. J. and Charles H.: "A Review of 1500 Operations upon the Gall-bladder and Bile Passages with Special Reference to Mortality," *Ann. Surgery*, 1906, xliv, 209.

² Kehr, Hans: "A Review of 720 Laparotomies for Gall-stones with Special Consideration of 90 Cases of Drainage of the Hepatic Duct," *Münch. med. Wochenschr.*, 1902, xlix, No. 41, 42, 43, S. 1688, 1748, 1800.

³ Robson, A. W. Mayo: "Common Duct Cholelithiasis: Its Symptoms, Complications, and Treatment," *Surg. Gynec. and Obstet.*, 1906, ii, 1.

⁴ *Loc. cit.*

⁵ Fenger, Christian: "Stones in the Common Duct and their Surgical Treatment," *Amer. Jour. Med. Sci.*, 1896, cxi, 125 and 286.

The jaundice of malignant disease is not accompanied by pain, it steadily increases, and does not vary from day to day, as it usually does in the case of common-duct stones. When the jaundice is due to some pressure from outside the duct, as a carcinoma of the head of the pancreas, the gall-bladder will be distended, while in cases where the obstruction is from a stone within the duct, the gall-bladder is usually contracted.

PATHOLOGY.

The inflammatory lesions of the gall-bladder and bile-ducts are essentially those of a tract lined with mucous membrane the anatomic relations of which are such as to make it subject to conditions of imperfect drainage.

Simple catarrhal inflammation limited to the mucous membrane is probably of relatively frequent occurrence, but, as a rule, it is only when this catarrhal inflammation is the cause of obstruction at some point that it assumes clinical or surgical importance. Such catarrhal inflammation is characterized by an increased production of mucus and, as pointed out by Naunyn, an excessive formation of cholesterin. The "sandy" appearance of the bile noted at operation in these cases is due in part to the cholesterin crystals and in part to epithelial detritus and bile-stained bits of mucus.

The more severe inflammatory lesions are, as a rule, dependent upon obstruction, and are of a diffuse type, involving all coats of the gall-bladder or ducts. These lesions are usually accompanied by more or less extensive fibrinous peritonitis, resulting in the formation of adhesions to the neighboring organs, especially the stomach, duodenum, colon, and omentum.

The character of the inflammation may vary from a simple congestion with leukocytic infiltration to the most severe suppurative or even gangrenous types. In the presence of gall-stone, ulceration of the mucous and even of the submucous and muscular coats is a frequent and characteristic occurrence and may result in perforation or the formation of fistulas, as described elsewhere. Gangrene of the gall-bladder is but rarely met with, probably owing to the free blood-supply of the organ, not only through the branches of the cystic artery, but also through their anastomosis with the hepatic vessels where the gall-bladder is attached to the liver.

With the subsidence of the acute attack and the re-establishment of free drainage either by natural or artificial means, the repair of even very severe lesions is rapid and surprisingly complete, as is often demonstrable in cases reoperated upon for other causes. On the other hand, if the causal factors of the inflammation persist, the continued irritation may result in the formation of irreparable lesions due to the excessive production of scar tissue.

INDICATIONS FOR OPERATION.

So long as the gall-stones simply remain in the gall-bladder without causing any complications, the harm to the patient is relatively slight. His comfort will not

be greatly disturbed on account of the disturbances in his digestion. The pain will not be extreme, and he usually accumulates an abundance of fat, especially in the abdominal walls. It has consequently been held by many authorities that it is not wise to make use of radical measures for the removal of gall-stones so long as they do not give rise to any grave disturbances. This undoubtedly would be a proper and reasonable view to take were the danger to the patient approximately the same before and after the occurrence of these complications. This, however, is not the case. Experience has shown us that the mortality in cases which are operated before any serious complications arise is practically *nil*, while the deaths which followed operation in the complicated cases undoubtedly might have been avoided had the operation been performed before these complications arose.

Mayo,¹ in his review of 1500 operations upon the gall-bladder and bile-passages, says: "It was the mortality and the complications of delay that placed the early operation for appendicitis on a sound surgical footing. To remove the disease while still in the appendix, and before its rupture involved the abdominal cavity, was the logical conclusion.

"The same reasons apply, and with equal force, to the early operation for gall-stone disease. Remove the disease while still in the gall-bladder with a mortality of from 1.47 per cent. (cholecystostomy) to 1.62 per cent. (cholecystectomy). This includes deaths from accidental causes, acute perforation, and gross infection. Excluding these cases, a mortality of less than 1 per cent. can be shown."

Mayo Robson² says: "As gall-stones are usually diagnosed in their early stage before danger has arisen, and as their removal at their early stage can be effected with very little risk,—at the outside, 1 per cent.,—it seems to me that the wisest course is not to wait for complications to arise, but to advise the removal of the disease at an early period and so prevent the serious sequelæ."

The complications which are likely to be caused by the presence of gall-stones may be chronic in character, taking the form of digestive disturbances and giving rise to almost constant discomfort. This condition is probably due to the interference with the passage of food through the pylorus into the duodenum, causing dilatation of the stomach.

Again, the patient may be in a slightly septic condition, because there is more or less absorption of the septic material from the infected residual bile as well as from the products of fermentation in the dilated stomach. These conditions frequently result in chronic invalidism, making it impossible for the patient to follow ordinary occupations and to enjoy life in any way. The constant irritation of the gall-bladder, due to the pressure of the gall-stones, undoubtedly has much to do with the development of carcinoma in this organ.

In cases of primary carcinoma of the gall-bladder I have always been able to get a history of gall-stones dating back many years, and I have invariably found

¹ Mayo, Wm. J. and Charles H.: "A Review of 1500 Operations upon the Gall-bladder and Bile-passages with Special Reference to Mortality," *Ann. Surgery*, 1906, xliv, 209.

² *Loc. cit.*

these present in the gall-bladder in such instances at the time of the operation or autopsy. Aside from these chronic conditions, gall-stones may at any time cause exceedingly grave acute conditions.

These complications are all the result of inflammation, and the sequelæ must consequently depend upon the extent to which this develops.

I take the following list of complications from Mayo Robson's excellent article on this subject, because its arrangement is most satisfactory:

1. Ileus due to paresis of the bowel, leading to enormous distention of the abdomen and to symptoms and appearances of acute intestinal obstruction, apparently the consequence of the violent pain.

2. Acute intestinal obstruction dependent on:

(A) Paralysis of gut due to local peritonitis in the neighborhood of the gall-bladder.

(B) Volvulus of small intestine.

(C) Stricture of intestine by adventitious bands, originally produced as a result of gall-stones.

(D) Impaction of a large gall-stone in some part of the intestine after ulcerating its way from the bile-channels into the bowels.

3. General hemorrhage, the result of long-continued jaundice, dependent either on gall-stones alone, or on cholelithiasis associated with malignant disease or with interstitial pancreatitis.

4. Localized peritonitis, producing adhesions which may then become a source of pain even after the gall-stones have been got rid of. I believe that nearly every serious attack of biliary colic is accompanied by adhesive peritonitis, as experience shows that adhesions are found practically in all cases where there have been characteristic seizures.

5. Dilatation of stomach depending upon adhesions around the pylorus.

6. Ulceration of the bile-passages, establishing a fistula between them and the intestine.

7. Stricture of the cystic or common duct.

8. Abscess of the liver.

9. Localized peritoneal abscess.

10. Abscess in the abdominal wall.

11. Fistula at the umbilicus, or elsewhere on the surface of the abdomen, discharging mucus, mucopus, or bile.

12. Empyema of the gall-bladder.

13. Infective and suppurative cholangitis.

14. Septicemia or pyemia.

15. Phlegmonous cholecystitis.

16. Gangrene of the gall-bladder.

17. Perforative peritonitis due to ulceration through or to rupture of the gall-bladder or ducts, leading to extravasation of infected bile into the general peritoneal cavity.

18. Pyelitis on the right side due to a gall-stone ulcerating, or an abscess of the gall-bladder bursting, into the pelvis of the kidney.
19. Cancer of the gall-bladder or ducts.
20. Subphrenic abscess.
21. Pleurisy or empyema of the right pleura.
22. Pneumonia of lower lobe of right lung.
23. Chronic invalidism or inability to perform any of the ordinary business or social duties of life.
24. Gangrenous or suppurative pancreatitis.
25. Chronic interstitial pancreatitis.
26. Infective endocarditis.
27. Cirrhosis of liver.
28. Appendicitis due to extension of inflammation from the gall-bladder or to impaction of a gall-stone in the appendix.

CONTRAINDICATIONS TO OPERATION.

In disease of the gall-bladder there are some definite contraindications to operation which, I believe, have now been quite thoroughly established by clinical observation.

1. It is ordinarily unwise to operate during the attack of gall-stone colic.
2. Severe icterus is a contraindication to a prolonged operation.
3. The same is true of prostration following long-continued suffering.
4. Cases complicated with carcinoma belong to the same class.
5. Patients with ecchymotic spots are almost certain to die if operated upon.

In all these cases if an operation must be performed it should be limited to drainage of the gall-bladder and removal of the stones in this viscus, and all further manipulations should be postponed until the patient is in a better general condition.

TREATMENT.

Gall-stones and severe infections of the bile-tracts have come to be looked upon as purely surgical conditions. However, it has been my experience that cases with acute exacerbation fare better if the operation is deferred until the acute symptoms have subsided. In any case complicated with an acute inflammatory condition I believe that the same general principles should be employed as in inflammatory processes involving the peritoneum from any other cause. So long as there is no circumscribed accumulation of pus, the treatment must consist in rest. This can be secured most readily by using gastric lavage in order to remove remnants of food or decomposing mucus from the stomach; then prohibiting the use of cathartics and food by mouth.

I desire especially to emphasize the value of securing absolute rest of the stomach by the use of gastric lavage; and then not placing any form of nourishment in the

stomach, but confining the patient exclusively to rectal alimentation. In the treatment of patients suffering from acute cholecystitis characterized by the presence of severe gall-stone colic, I have seen many cases in which the pain was excruciating and large doses of morphin given hypodermically failed to give relief, but in which the pain disappeared almost completely without further opiate after the use of gastric lavage. In these cases the pain does not recur unless some form of nourishment is given by mouth; even water often causes recurrence of pain.

It may be difficult to explain this observation, but it is likely that even a small amount of food or mucus in the stomach will be forced into the duodenum, and that when it passes over the entrance of the common duct, it causes a contraction of the gall-bladder, and this excites the pain.

The use of moist heat in the form of poultices or fomentations, or of cold by means of an ice-bag, gives the patient great comfort and is undoubtedly beneficial.

Morphin may be given hypodermically if necessary, but so long as neither food nor cathartics are given by mouth, the pain usually subsides rapidly and permanently. Nourishment may be given by enema not oftener than once in four hours, nor in larger quantities than four ounces at a time. I prefer for this purpose an ounce of one of the various reliable predigested foods mixed with three ounces of warm normal salt solution. Unless the acute condition is complicated with a mechanical obstruction of the intestines, the patient's chances for recovery from the acute attack are far better without than with an operation.

It is necessary to make a definite distinction between intestinal obstruction due to peritonitis and the same condition due to a mechanical obstruction, such as the impaction of a gall-stone. The former is so much more common that it is only very seldom that the latter need be considered. Mechanical obstruction due to impaction of a gall-stone is characterized by the sudden onset of symptoms of an acute intestinal obstruction, without the inflammatory symptoms which must be present if it was due to a peritonitis.

When the patient has recovered from his acute attack, the further treatment may be medical, which will not cure him, but may improve his condition very greatly; or surgical, which is likely to result in a perfect permanent recovery.

The medical treatment must consist chiefly in the use of large quantities of water, preferably taken hot, and in the use of a diet fairly free from sugar and starch.

I believe, however, that the greatest benefit comes from drinking a great amount of good water and never eating quite enough to satisfy hunger, and from taking vigorous out-of-door exercise, such as horseback-riding, walking, or rowing. Sodium phosphate in dose of one dram or more, taken in a large goblet of hot water, half an hour before each meal, and pure olive oil taken in dose of one-half to four ounces at bedtime, seem to have given relief to patients suffering from gall-stones. Many patients remain free from severe attacks for a long period of time by employing these remedies together with proper diet and exercise.

Whether relief is due to the fact that in this manner constipation is prevented and elimination is facilitated by the large drafts of hot water, or whether there is

some special virtue in the remedies, it is difficult to say. That many of the patients are relieved of their gall-stone colics upon following this plan of treatment there can be no doubt. It is plain, however, that this form of treatment can be of benefit only to a limited number of patients, namely, those in whom there is no impaction of the gall-stones in the gall-bladder or in the common or cystic duct, and which are not complicated with serious lesions of any part of the mucous membrane or with extensive adhesions. Moreover, these patients are apt to have recurrences with one or more of the complications enumerated above. Aside from this, there is always the danger of carcinoma as a result of the long-continued irritation.

For all cases, then, which cannot be relieved in this manner with some degree of permanency, and for those who are unwilling to undergo continuous medical and hygienic treatment, nothing remains but the removal of the gall-stones by an operation.

Preparation of Patient for Operation.—The first step in the preparation of the patient after entering the hospital, or after an operation has been decided upon, is once more to make a thorough examination of the patient, either in person or, better still, by an equally competent associate. This examination should be made independently by the associate, and then the results should be compared. It should be made in a systematic way, and in hospital practice at a stated period, so that enough time will be allotted to make it thorough. It is extremely easy to form careless routine habits unless one constantly follows a definite scientific plan.

It is true that this plan increases the amount of labor materially and that it is rare that any new facts are determined by the second examination, but it is just in the few cases that it proves to be of the greatest importance.

In this systematic examination many things are considered which may not have any bearing upon any given case in question, but when applied to all the cases in practice, each point is of considerable importance.

After all of the conditions present in the case have been determined, the necessary preparations for the operation may proceed.

If there exists a serious complicating disease, *i. e.*, if the heart, lungs, kidneys, or blood be seriously impaired, it is well to overcome this fault unless it is directly the result of a condition which is to be relieved by the operation itself and which will probably improve much more rapidly after than before the operation. If no vital organ is seriously impaired, it is much better not to worry the patient unnecessarily before the operation. As a rule, a long-continued preparation leaves the patient in a less favorable condition for a surgical procedure than a very short and simple preparation, which serves to put the kidneys, the skin, and the alimentary canal in a condition favorable to the elimination of waste products.

This is accomplished by giving the patient two ounces of castor oil twenty-four hours, and one or two enemata eight and twelve hours, before the operation. Gastric lavage is performed just before operating.

During the twenty-four hours previous to the operation only sterilized liquids are given by mouth, together with an abundance of hot water.

Some attention should be given to the condition of the mouth. In most patients it is well to have the teeth cleansed by means of a tooth-brush, and an antiseptic mouth-wash used every four hours, and oftener in cases where there are decayed teeth.

In very obese patients it is a good plan to give a strict diet for some weeks previous to the operation. This should contain an abundance of lean beef or mutton, and almost no starch, sugar, or fat. In the mean time the patient should take vigorous exercise, and the abdominal walls should be massaged systematically. I have many times reduced the weight of obese patients fifty or more pounds, and in one case one hundred and forty pounds, at the same time greatly increasing the patient's strength and comfort.

In cases where there is marked jaundice, calcium chloride, in dose of one dram, given in a pint of hot water three times the day previous to the operation, seems to be valuable in increasing the coagulability of the blood.

In many patients there is an especially tense abdominal wall, which may refuse to relax even after the administration of an anesthetic. In these cases it is well to administer one-fourth of a grain of morphin, preferably with $\frac{1}{100}$ grain of atropin, hypodermically half an hour before the operation.

The Field of Operation.—The important point in preparing a surface for operation lies in the thorough washing with soap and water; anything that is done beyond this is of little importance provided the washing process has been done carefully and thoroughly.

In my practice the steps taken to prepare the field of operation are as follows:

1. Thorough scrubbing with soap and warm water, with a soft brush.
2. Washing the surface with a piece of aseptic gauze with fresh water, because the epithelial cells which have been loosened by the brush are easily removed in this manner.
3. Soaping and shaving the field of operation.
4. Washing again with aseptic gauze and sterile water.
5. Washing the surface with alcohol.
6. Washing with a solution of corrosive sublimate, one part in two thousand.

In hospitals where many operations are performed on the same day, so that the time spent on each case immediately preceding an operation is of importance, it may be well to prepare the field of operation the day before, and then protect the surface from reinfection during the interval by applying a sterile gauze dressing. At the time of operation this dressing is removed and the field of operation sponged with sterile gauze and alcohol.

This is done simply for convenience and not because it is better than to prepare the field of operation immediately before beginning to operate. For months at a time I have followed the latter plan without having a single wound infected, and other surgeons have had the same experience.

Operation.—In operations upon the gall-bladder, and especially those upon the bile-ducts, considerable advantage can be gained by placing a sand-bag 20 to

30 cm. in diameter under the patient's back, at or a little above the level of the liver. This will cause the liver to present in the wound and afford easy access to the cystic and common ducts. This position is illustrated in Fig. 543.

For all gall-bladder operations a straight incision made through the right rectus muscle, near its outer border, is undoubtedly the best, primarily. The upper end of the incision starts at the costal margin and extends downward. The incision is first carried through the skin, superficial and deep fascias, down to the muscle-fibers. These should be separated longitudinally, by means of a blunt instrument like the handle of a scalpel, so that none of the fibers are cut. The incision is completed by carrying it through the transversalis fascia and the peritoneum. The incision should be long enough to admit the entire hand, as advised by Maurice



FIG. 543.—MAYO ROBSON'S POSITION OF PATIENT FOR GALL-BLADDER AND GALL-DUCT OPERATION.

Richardson. This is important because the next step must consist in a careful palpation of the gall-bladder, the cystic, the hepatic, and the common ducts. This cannot be done thoroughly without introducing the entire hand.

The pancreas and the duodenum and the pylorus should be examined at the same time.

The various incisions used in operations upon the gall-tract are illustrated in Fig. 544.

Should it be found that more room is needed than the rectus incision gives, it may be obtained by carrying the upper end of the incision upward and inward, cutting the rectus fibers about one inch from the costal margin, which virtually converts our primary rectus incision into one first suggested by Mayo Robson. Or this rectus incision may be converted into the "S"-shaped incision as devised by

Bevan. It is rare, though, that there will be need for any other than the straight rectus incision.

Cholecystotomy.—The simplest operation upon the gall-bladder is cholecystotomy.

The simplest form of this operation, suggested by Meredith more than twenty years ago, consisting in the removal of the gall-stones and the immediate suturing of the gall-bladder with Lembert's sutures, has been almost entirely abandoned, except in cases in which gall-stones are incidentally discovered in a practically normal gall-bladder during an

operation for some other intra-abdominal condition.

There are a few surgeons who still favor this operation for all cases of gall-stones without a marked degree of cholecystitis; among them, no less an authority than Kocher.

In every step except the last this operation corresponds to that of cholecystostomy, consequently the two operations will be described together up to this point. Both of these operations are performed for the purpose of removing stones from the gall-bladder, and in some cases from the cystic duct.

Colecystotomy is further performed for the purpose of establishing drainage of the gall-bladder, which is useful not only in relieving



FIG. 544.—INCISION FOR GALL-BLADDER AND GALL-DUCT OPERATION. No. 1, Mayo Robson's incision; No. 2, Bevan's incision; No. 3, Kocher's incision.

irritation of the gall-bladder and biliary ducts, but also indirectly, it seems, to drain the liver and the pancreas, and as a result of this drainage these organs, when generally enlarged as a result of chronic inflammation or irritation due to faulty drainage, will decrease in size very rapidly.

It is consequently important to determine these conditions before deciding upon the operation to be chosen in any given case. After making the incision, the hand is introduced into the abdominal cavity and the gall-bladder is palpated between

the finger and thumb. It is then followed downward and inward and the cystic, the hepatic, and the common ducts are palpated in succession.

Occasionally the gall-bladder may be so tense that nothing can be determined concerning the character of its contents, except that whatever the gall-bladder may contain it is impossible for this substance to pass on freely into the duodenum, and this, in itself, is the strongest indication for a cholecystotomy. If this condition is found, or if gall-stones are found in the gall-bladder or the cystic duct, but none in the hepatic or common ducts, this operation is plainly indicated.

The examination may have revealed more or less extensive recent or old adhesions between the gall-bladder and the surrounding organs.

These adhesions may include the liver, the omentum, the transverse colon, the duodenum, or the stomach, and in some instances even the right kidney, or they may include any two or more of these organs.

If they are recent, or if they distort one or more of these organs, it is well to loosen or to ligate and cut these adhesions. If they have existed for a long period of time without apparently doing any harm, it is better to leave them undisturbed. It must, however, be borne in mind that undoubtedly the adhesions of the gall-bladder frequently draw this down and cause it to become sacculated so that it will contain residual bile, and that this in turn favors infection of this fluid, and thus the formation of gall-stones. It is consequently important to remove any adhesions which seem to show a tendency to cause sacculatation of the gall-bladder.

This having been accomplished, soft gauze pads moistened with warm normal salt solution are placed about the gall-bladder after the latter has been grasped at its most prominent point with one or two pairs of forceps.

This act of packing away the remaining portion of the peritoneal cavity should be done with the greatest care, to prevent soiling during the succeeding steps of the operation.

A trocar is then plunged into the gall-bladder to drain away the bile, or pus, or mucus, as the case may be, contained in the cavity. The trocar shown in Fig. 545 is undoubtedly most convenient, because with it the gall-bladder can be emptied perfectly without the slightest danger of soiling any of the surrounding tissues.

Should the gall-bladder be contracted because of the long-continued destructive

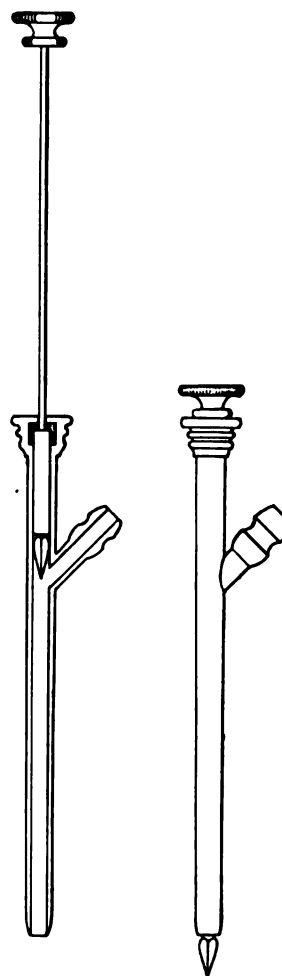


FIG. 545.—TROCAR FOR ASPIRATING THE GALL-BLADDER.

inflammation which distinguishes old gall-stone cases from obstruction due to malignant growths according to the law of Courvoisier, it might not be necessary to make use of the trocar, because there will be no bile in what is left of the gall-bladder. In these cases the most prominent portion of the gall-bladder is grasped by the forceps and an incision made through the highest portion, which is also the next step after the fluid has been aspirated in the other class of cases.

If there is still a little fluid present, this is absorbed by lightly tamponing the cavity of the gall-bladder with a narrow strip of aseptic gauze and withdrawing it. This can be repeated a number of times. A blunt gall-stone scoop is now introduced and gently withdrawn, bringing out as many of the stones as can be reached in this manner (Fig. 546).

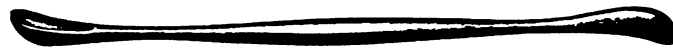


FIG. 546.—GALL-STONE SPOON FOR REMOVING STONES FROM THE GALL-BLADDER.

Then, while an assistant holds up the gall-bladder by hemostatic forceps attached to the edge of the wound,

the surgeon's hand is again introduced into the abdominal cavity, and the gall-bladder and all its ducts are once more carefully palpated.

If there are still stones present, these can be removed with the scoop, guided by the hand in the abdominal cavity. If there are stones in the cystic duct, these can frequently be forced back into the gall-bladder by a gentle milking motion between the forefinger and thumb. Occasionally this can be aided by the use of a small curet guided by the other hand.

In a few instances it has been possible to transfer to the gall-bladder not only stones in the cystic duct, but even those in the common duct and hepatic duct, in this manner. Great caution must, however, be practised, because less injury is done to the patient by making an incision into these ducts than by severe manipulation in the attempt at removing stones, especially if these are immovable as the result of impaction.



FIG. 547.—GALL-STONE FORCEPS (Moynihan).

So far the steps of the operation are agreed upon practically by every one who has a large experience in the treatment of these cases. From this point on, authorities of equal ability vary in the details of their technic.

I have used at various times most of the methods which have been recommended, thinking that one might be indicated under certain conditions, while another might be more suitable for a slightly different condition, but I am convinced that the special benefits from these various operations are entirely imaginary.

In more than three hundred successive cases I have employed the following simple technic, after being satisfied that all the stones had been removed.

1. The gall-bladder is carefully but gently and loosely tamponed with a long strip of dry gauze. This serves to prevent hemorrhage from the mucous lining of

the gall-bladder, which is frequently severely congested, and often covered with bleeding granulations.

2. The transversalis fascia and the peritoneum of the upper angle of the wound are then sutured to the gall-bladder, 1 to 2 cm. from the edge of the opening into it.

Fig. 548 shows the gall-bladder with the forceps upon its edge and drawn out through the wound, and a catgut stitch being placed which attaches the gall-bladder to the peritoneum. The stitch in the gall-bladder passes down to, but not through, the mucous lining of the gall-bladder.

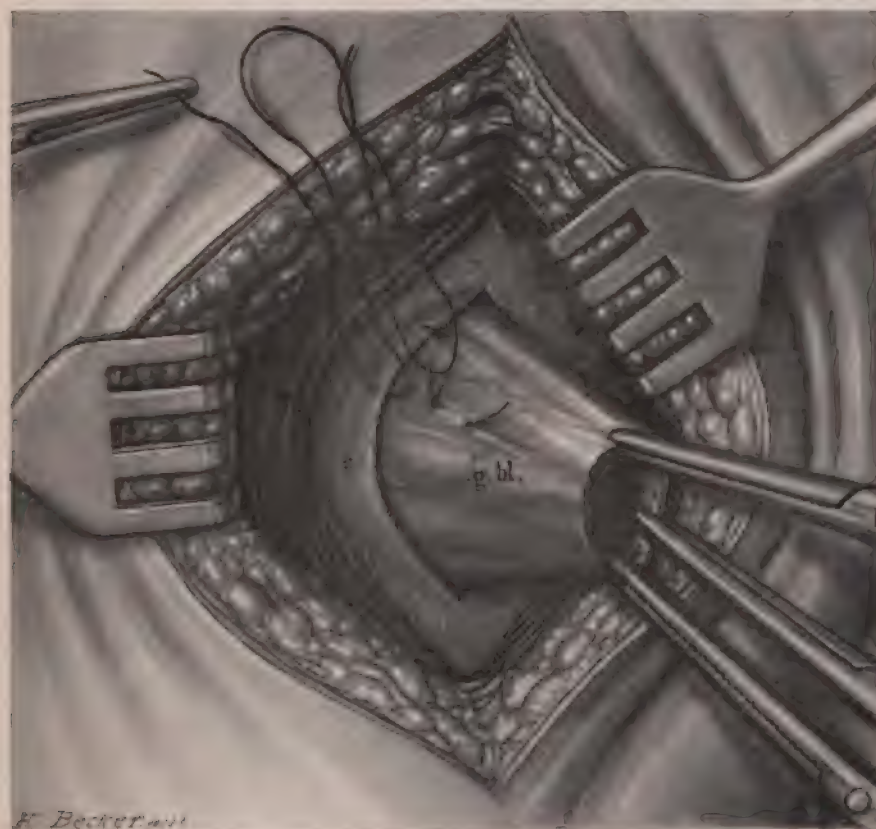


FIG. 548.—SHOWS GALL-BLADDER WITH FORCEPS UPON ITS EDGE AND BEING SUTURED TO THE PERITONEUM.

If the gall-bladder is small and shrunken, the peritoneum and the transversalis fascia are brought down to it at one or two points, and a piece of gauze is carried down to the gall-bladder, and between the gauze and the surrounding tissue a piece of rubber tissue is placed. Attaching the gall-bladder in this manner facilitates drainage and prevents the gall-bladder later on from becoming sacculated.

3. The incision above and below the gauze drain is closed after the general plan illustrated in Fig. 549, showing the closure of a laparotomy wound in the

median line. This differs from the closure of the gall-bladder incision through the right rectus abdominis muscle, in that the second row of catgut sutures unites the

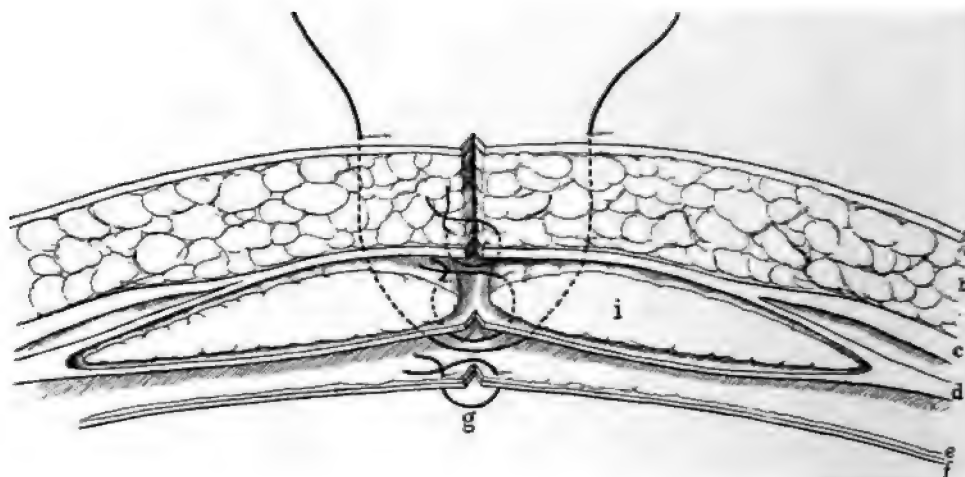


FIG. 549.—CROSS-SECTION OF ABDOMINAL WALL SHOWING CLOSURE OF WOUND AFTER A MEDIAN INCISION.
a, Skin; b, subcutaneous fat; c, aponeurosis of external oblique abdominal muscle; d, aponeurosis of internal abdominal muscle divided into inner and outer layer; e, connective tissue; f, transversalis fascia and peritoneum; g, line of suture; i, rectus abdominis muscle.

two abdominis muscles, instead of the two split edges of the right rectus abdominis muscle. Two of the fine silkworm-gut stitches are passed through all the tissues down to but not through the transversalis fascia; these are left untied until the following rows of catgut sutures have been applied in order to prevent the formation of a ventral hernia, by carefully approximating the following layers: (a) peritoneum and transversalis fascia; (b) rectus abdominis muscle; (c) aponeurosis of the external and the outer layer of the internal oblique muscle passing in front of the rectus abdominis muscle at this point; (d) the skin.

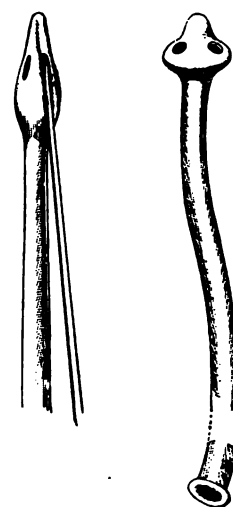


FIG. 550.—JACORS' RETENTION CATHETER.

These layers are all approximated by suturing with unchromicized catgut, except the skin, for which horsehair is used. The closure of the wound is completed by tying the silkworm-gut sutures.

4. Some rubber tissue is now stuffed down to the gall-bladder, between the edges of the abdominal wall and the gauze tampon, to facilitate its removal. This is done about the fifth day, when a rubber drainage-tube is inserted into the gall-bladder.

The other methods which seem equally satisfactory consist in using, instead of a gauze tampon, a simple rubber tube, or a split rubber tube filled with a strip of gauze, or a cigarette drain. Any one of these may be fastened in the gall-bladder by placing a pursestring suture around the opening, invert-

ing the edges, and then drawing the pursestring just sufficiently tight to prevent leakage.

Still another method consists in applying one of these various forms of drainage, and then simply permitting this to project from the upper angle of the abdominal wound without suturing the gall-bladder to the parietal peritoneum. Personally, I have never been favorably impressed by this method.



FIG. 551.

L. Liver; *G. bl.*, gall-bladder; *D.*, duodenum.

Cholecystotomy.—Going back to the point at which we had arrived after removing all of the gall-stones, the opening in the gall-bladder may be closed by slightly inverting the edges and applying one row of fine continuous catgut suture, including all of the layers, a second row of continuous Lambert sutures over this, also of fine catgut, dropping the gall-bladder, and closing the abdominal wall;

or a small iodoform gauze wick may be carried down to the suture row and passed out through the upper angle of the wound.

It has always seemed to me that much benefit in gall-bladder cases comes from the drainage of the gall-bladder after operation, and that consequently cholecystotomy is practically never indicated.

Continued Drainage of the Gall-bladder.—In case it seems wise to continue the drainage of the gall-bladder for a considerable period the patient can be made more comfortable by inserting a Jacobs retention catheter of proper size into the gall-bladder, attaching a glass tube to the distal end of this catheter, and tying a

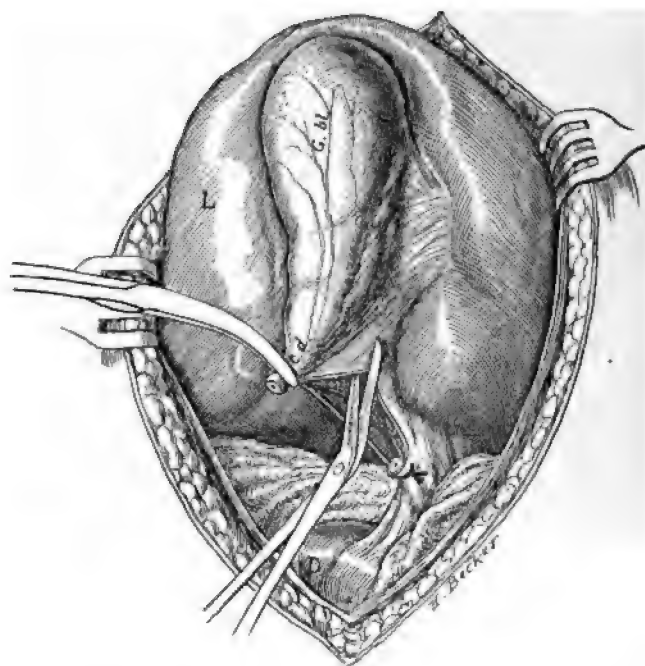


FIG. 552.—CUTTING OF PERITONEAL FOLD BETWEEN GALL-BLADDER AND LIVER AFTER CYSTIC DUCT HAS BEEN CLAMPED AND SEVERED.

L, Liver; *G. bl.*, gall-bladder; *c. d.*, cystic duct; *D*, duodenum.

soft-rubber bag to this in order to collect the bile. Whenever it seems proper to interrupt this drainage, the opening will close spontaneously upon withdrawing the catheter.

Cholecystectomy.—This operation is indicated in cases in which there is a permanent obstruction of the cystic duct, which is usually due to a cicatricial contraction of an ulcer, most commonly caused by the impaction of a stone.

It may also be due to the formation of a valve in the neck of the gall-bladder at its entrance into the cystic duct. Occasionally such a valve will permit the free flow of bile into the gall-bladder, but not in the opposite direction.

Cholecystectomy should be performed in early cases of primary carcinoma of the gall-bladder. In some cases in which the gall-bladder has been badly diseased

for some time, the disease being limited to the organ alone, and circumstances permit of easy removal, cholecystectomy will be the operation of choice.

The removal of the gall-bladder is usually not a difficult matter if it is approached from the right direction. The following simple steps should be followed:

1. The same incision as in cholecystostomy should be made. Occasionally if there are many adhesions, so that it is difficult to reach the lower end of



FIG. 553.

L., Liver; *G. bl.*, gall-bladder; *S.*, stone in cystic duct; *D.*, duodenum.

the gall-bladder, the incision may be lengthened, according to the plan advised by Bevan, by extending the upper end of the incision inward and the lower end outward, or it may be extended according to Mayo Robson, between the edge of the costal cartilages and the lower end of the sternum, in order that the liver with the gall-bladder may be inverted upward.

2. Two pairs of hemostatic forceps are then applied, one directly to the cystic

duct, grasping at the same time the cystic artery which supplies the gall-bladder; the second pair is applied to the neck of the gall-bladder at a distance of 1 cm. from the other. Fig. 551 shows the two pairs of forceps in place. The neck of the gall-bladder is divided between them.

3. An incision is now made along the sides of the gall-bladder, through its peritoneal covering, about 1 cm. from its attachment to the liver, and then the organ can be enucleated without difficulty, as shown in Figs. 552 and 553.

If there is any considerable amount of hemorrhage from the surface, a hot tampon of gauze against the surface for five minutes will control the oozing at once,

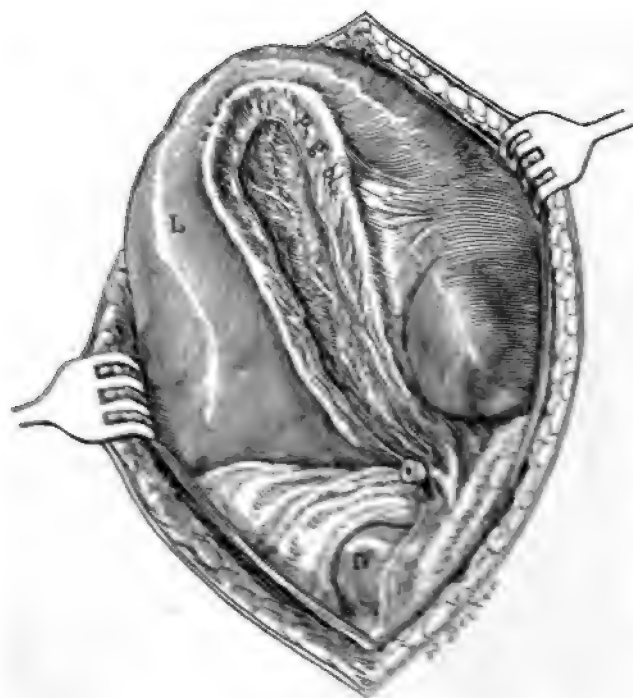


FIG. 554. Liver and gall-bladder after removal. L, liver; P, peritoneum of gall-bladder; G, gall-bladder.

and then the raw surface can be closed by suturing together the two peritoneal folds with catgut as shown in Figs. 555 and 556.

Fig. 555 shows the upper surface of the liver after the gall-bladder and the cystic duct have been removed. Fig. 556 shows where the two edges of the peritoneum have been sutured together over the raw surface made by excising the gall-bladder. Fig. 557 shows the lower surface of the liver, the hepatic duct, which is pulled downward for sake of illustration.

4. Dissection of the stump of the cystic duct is not required; a ligature can be placed about the stump of the cystic duct, and the cystic artery, as shown in Fig. 558.

If the necessity for drainage is not felt, the cystic forceps may be left in place.

and may be surrounded by gauze and rubber protective, and permitted to pass out of the upper angle of the wound. This may be loosened after thirty-six hours, or sooner if it should become apparent that drainage is desired.

It is well in these cases to insert a drainage-tube to a point just below the stump for the purpose of providing for an emergency. It is immaterial what form of drainage-tube is chosen. In case drainage of the cystic duct is desired, the cystic artery is caught separately at the end of the stump and ligated and a small rubber drainage-tube is introduced directly into the common duct through the cystic duct.

Fig. 557 shows a drainage-tube which is most useful in these cases. A small rubber drainage-tube (*a*) is drawn through a larger tube (*b*), the perforated end (*c*)

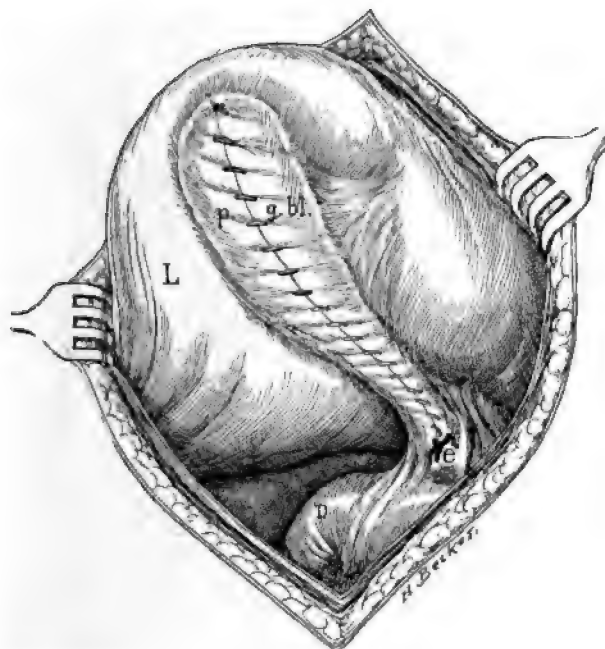


FIG. 555.—SHOWING TWO EDGES OF PERITONEUM OF GALL-BLADDER SUTURED AFTER EXCISION OF GALL-BLADDER.
L, Liver; p. g. bl., peritoneum of gall-bladder; D, duodenum; c, ligated cystic duct.

is introduced into the cystic duct, and it is held in place by one or more catgut sutures, which pass through the outer tube (*b*) but do not touch the inner tube. By the time the catgut is absorbed, it is time to withdraw the drainage-tube.

The abdominal wound is closed as in the previous operation, and the tissues are prevented from adhering to the gauze by the interposition of the rubber tissue.

Occasionally the surface of a gall-bladder in which there is positive indication for cholecystectomy is so strongly adherent that it may be difficult or impossible to perform the operation just described.

For the relief of these cases W. J. Mayo has advised the following operation, which I have performed with perfectly satisfactory results, both as regards immediate and late conditions.

The operation consists in making a circular incision through the tissues of the gall-bladder down to but not through the mucous membrane. The latter is then dissected down to the cystic duct, and the operation is completed as in ordinary cholecystectomy.

Choledochotomy.—In operating on the common duct a sand-bag is always placed under the back opposite the liver, as advised by Mayo Robson. The usual straight incision is made through the right rectus abdominis muscle. If it is found necessary to open the common duct and more room is desired, the incision is carried upward and inward between the right costal margin and the ensiform cartilage.

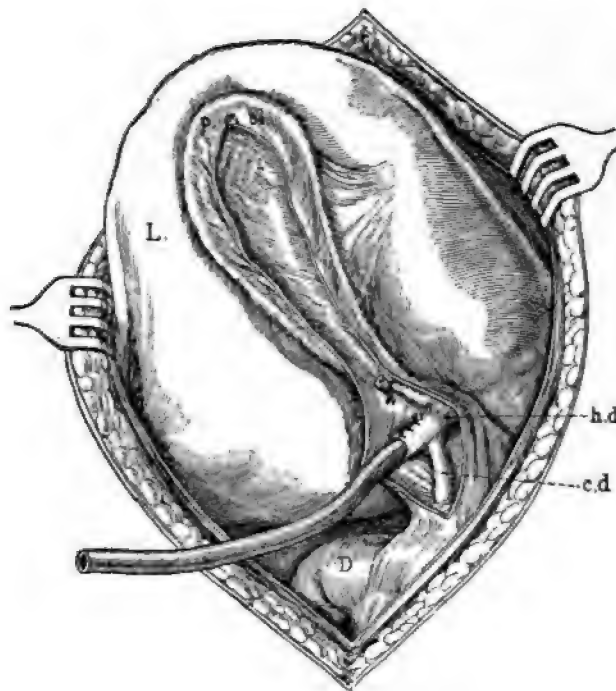


FIG. 556.—SHOWS RUBBER DRAIN PLACED IN THE HEPATIC DUCT, WHICH IS PULLED DOWNWARD FOR SAKE OF ILLUSTRATION.

L, Liver; *p. g. bl.*, peritoneum of gall-bladder; *h.d.*, hepatic duct; *c.d.*, cystic duct.

Now, by lifting the lower edge of the liver out of the wound, it will be found that the gall-bladder and the cystic and common ducts will be brought into plain view. The liver is held in this position by an assistant, who grasps the lower edge of the liver with his fingers covered with a piece of dry gauze. When the liver is held in this position, it will be found that the cystic and common ducts make an almost straight passage from the neck of the gall-bladder to the entrance into the duodenum.

If there are adhesions about the ducts, these are separated, a sponge is placed in the kidney pouch, and the entire field of operation is protected by sterile pads.

The stone is located and grasped between the thumb and finger of the left hand. While the stone is held in this position, two catgut sutures are placed in the side of

the common duct directly over the stone. These sutures are left long. A little tension is made upon the sutures, then the duct is opened by making a longitudinal incision between the two sutures directly over the stone.

Fig. 558 illustrates a stone in the common duct, and a catgut suture applied to each side of the proposed incision, and the incision made directly over the stone.

After all obvious stones have been removed, the finger should be passed into the duct to detect any stones that may be above or below the incision.

Any sand or thick bile is removed by packing strips of gauze into the duct in the manner described in sponging out the gall-bladder. When the duct is clear, the incision in it may be closed by suture or may be drained. If there is not much evidence of infection of the common duct, and the gall-bladder looks healthy and the cystic duct is patent, the wound in the common duct can be closed with safety, leaving drainage of the bile through the gall-bladder only. The incision in the duct is closed by first approximating the edges with a fine continuous catgut stitch, and over this a few Lembert stitches of silk. A cigarette drain is placed down to the common duct and brought up out of the incision by the side of the gall-bladder drain.

The majority of the cases require drainage of the common duct, especially in those where the head of the pancreas is enlarged from chronic pancreatitis.

A double drainage-tube, as shown in Fig. 557, is inserted into the common duct and carried upward toward the hepatic duct. The two catgut sutures which were placed in the sides of the duct as guides are now utilized to fasten the drainage-tube in place, which is done by passing the sutures through the outer rubber tube and tying. These sutures are still left long.

A piece of iodoform gauze is packed around the tube and brought up out of the wound by the side of the drainage-tube to further protect the peritoneal cavity. These same sutures are now passed through the gauze and tied so that there can be no displacement of the gauze should the patient vomit after the operation.

The operation is completed by closing the wound in the usual manner.

Cholecystenterostomy.—This operation is indicated in cases in which there is a permanent obstruction between the entrance of the hepatic duct into the common duct and the opening of the latter into the duodenum.

The entire alimentary canal should be thoroughly emptied by the administration of two large doses of castor oil, forty-eight and twenty-four hours before the opera-

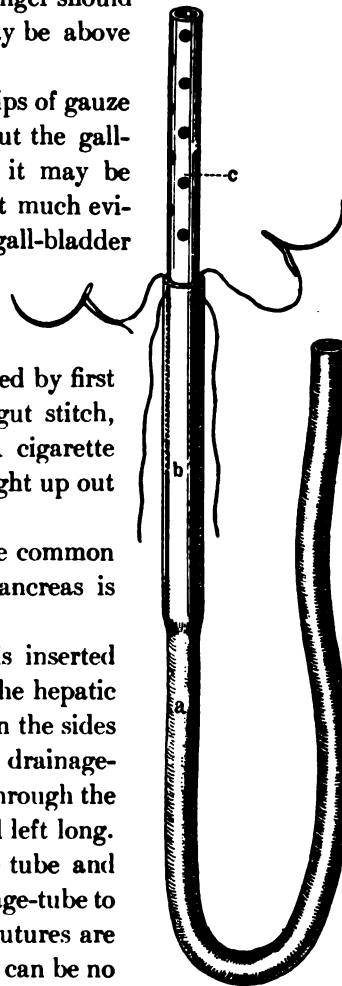


FIG. 557. — DOUBLE DRAINAGE-TUBE USED FOR DRAINING CYSTIC OR COMMON DUCTS.

tion. A careful anastomosis from 1 to 2 cm. in length should be made between the gall-bladder and the duodenum by any one of the various methods employed in making intestinal anastomosis with needle and thread. If anastomosis with the duodenum is difficult, the jejunum, ileum, or the hepatic flexure of the colon may be



FIG. 558.—SHOWS STONE IN COMMON DUCT AND A CATGUT SUTURE PLACED TO EACH SIDE OF THE PROPOSED INCISION, AND THE INCISION MADE DIRECTLY ON THE STONE
L, Liver; G.bl., gall-bladder; D, duodenum.

used. If a mechanical device is employed, the small Murphy button should be chosen, but the suture seems to be a superior method.

After-treatment.—When the operation is completed, a dry sterile gauze dressing is applied and held in place by a snug abdominal bandage, so that if vomiting should occur, the wound will receive some support from the bandage.

No water is allowed by mouth until the ether sickness and the nausea are over. If the thirst is great, the mouth may be flushed frequently with water and an enema of a pint of salt solution may be given. If the pain is severe, morphin in doses of $\frac{1}{8}$ to $\frac{1}{4}$ of a grain may be given hypodermically.

Four to eight ounces of normal salt solution are given by enema every four hours during the first day. Then nourishing enemata in the form of one ounce of some concentrated liquid predigested food, with four ounces of normal salt solution are administered every four hours for two or three days.

As soon as the nausea from the anesthetic is over, small quantities of water are given by mouth, and on the third or fourth day beef-tea or broth, increasing the diet slowly from this time on.

The wound is dressed daily with dry sterile gauze, and on the fourth day the gauze is removed from the gall-bladder and a rubber tube substituted, which in ordinary cases is removed at the end of a week or ten days, and the wound allowed to close. In cases accompanied with pancreatitis or a marked cholangitis the drainage is continued for a period of from two to four weeks. The stitches are removed on the twelfth day and the patient is allowed to get up at the end of from fourteen to eighteen days.

THE LIVER.

ABSCESS OF THE LIVER.

Dysentery is by far the most frequent cause of abscess of the liver¹ (524 out of 699 cases, Edwards and Waterman).

The condition is very common in the tropical countries, where various inflammatory conditions of the bowels produce a thrombophlebitis of the mesenteric vein; the clots decomposing become dislodged and carry the infection through the branches of the portal vein, producing foci of suppuration. In hot climates they are known as tropical abscesses. The *amaba dysenteriae* have frequently been found in the pus from these lesions.

Liver abscess, besides occurring during the course of dysentery, may be due to gall-stones, typhoid fever, intestinal ulcers, inflammation in the region of the portal vein, trauma, and syphilis; it may also be a complication of suppurative appendicitis. Liver abscess has resulted also from actinomycosis.²

Symptoms.—The most constant symptoms as observed by Johnston³ are: (1) A history in which dysentery and chills appear. (2) Pronounced general malaise. (3) Pain and tenderness over liver. (4) Enlargement of the liver. (5) Hectic sweats and rigors. (6) Right lateral posture. (7) Irregular temperature, running from 96.5° to 103.5° F. (8) Progressive emaciation. (9) Gastric disturbances.

¹ Fowler, George Ryerson: "A Treatise on Surgery." 1906, ii, 43.

² "International Textbook of Surgery." Phila., 1902, ii, 450.

³ Johnston, George Ben: "Contribution to the Surgery of Hepatic Abscess," Ann. Surgery, 1897, xxvi, 424.

Pain in the region of the liver is usually an early and prominent symptom. The pain often follows the course of the phrenic and the fourth cervical nerves and radiates toward the right shoulder. It is usually constant from the onset. By carefully noting the exact limits of the pain and tenderness, the abscess may often be located. Pain is always increased by digital pressure.

Enlargement of the liver is perhaps the most invariable objective symptom, and usually causes a bulging of the right hypochondrium. The enlargement may take place in any direction. The expansion takes the course of least resistance and may be the means of determining the seat of the abscess.

Prognosis.—The prognosis is unfavorable, especially in cases of multiple abscess. The patient may succumb to the primary infectious disease, or to pyemia or sepsis, or the abscess may rupture into the peritoneal cavity, causing a septic peritonitis, or it may rupture into the pleural cavity, resulting in septic pneumonia.

Treatment.—The treatment is operative. The liver must be reached by crossing either the pleura or the peritoneum, and the route must be chosen according to the location of the abscess. If there is reason to believe that the abscess is not pointing toward the pleura or has not ruptured into it, the liver is reached by preference through the peritoneal cavity by making an incision high up through the right rectus abdominis muscle. The abdominal cavity is carefully walled off by gauze pads. If the abscess is not readily discovered, the liver may be explored by means of an aspirating needle. The abscess is then incised freely and the cavity packed with iodoform gauze. Other pieces of iodoform gauze are so arranged as to protect the general peritoneal cavity and are brought out through the incision.

In cases in which the abscess is evident on exposure of the liver the operation may be done in two stages. The surface of the liver at the point of suppuration is exposed, and the wound is packed with iodoform gauze and left three or four days until adhesions have formed, when the operation is completed.

In passing through the pleura it is necessary to resect one or more ribs. When the parietal pleura is incised, its edges are caught by hemostatic forceps. The diaphragmatic pleura is now incised and its margin sewed to that of the parietal pleura so as to close the pleural cavity. The operation is completed by incising through the diaphragm and draining the abscess freely.

In cases in which there is redness and edema of the skin, making it evident that adhesions exist, the abscess may be incised directly.

Johnston¹ says: "Treatment should be prompt, bold, and radical. No measure will succeed which does not completely evacuate the abscess cavity and allow free drainage. This can be done with precision and safety only by incision. Aspiration, puncture with trocar, direct puncture with scalpel, opening by caustics or the thermocautery are uncertain, insufficient, dangerous, and unsurgical, and are mentioned only to be condemned." He reports eighteen cases of abscess of the liver. The first eleven were treated by aspiration: ten died, one recovered. In the second

¹ Loc. cit.

group of seven cases, two refused operation; both died. Five were treated by incision and drainage, four recovered and one died.

O'Connor¹ reports six cases of abscess of the liver, all treated by incision and drainage. Five recovered, one died.

HYDATIDS OF THE LIVER.

This disease is caused by a parasite known as the *tania echinococcus*, whose normal habitat is the intestinal canal of dogs, jackals, and wolves. The disease is most prevalent in Australia and in Iceland, where the natives are not cleanly and live in close association with these animals.

The tæniæ are taken into the alimentary canal with the food, or more commonly with drinking-water. According to Fowler,² their albuminous envelop is partly digested in the stomach, and, thus set free, they burrow into the tissues and most frequently enter a radicle of the portal vein and are thus carried to the liver.

There is some question as to what becomes of the liver tissue when these large cysts develop in the organ. Some authors believe that an atrophy takes place, while others think that a hypertrophy occurs. Frank³ believes that the liver tissue is never destroyed to any physiologic extent, but that by the slow growth of the cyst within the liver the organ gradually becomes compressed, as a lung would be by a pleural effusion.

When the cyst is fully developed there is a sac filled with fluid in which float smaller cysts known as daughter cysts, and sometimes there are tertiary cysts inside of these.

The hooklets of the parasite are usually found in the cyst wall.

The cysts may exist for many years and only be discovered at autopsy. The great danger is that they may rupture; however, this is not necessarily fatal, as they may rupture externally or into the intestinal canal. A cure may result in this manner. If the rupture occurs into the pleural cavity, gall-bladder, or peritoneal cavity, it is almost invariably fatal. If infection occurs, the disease may resemble a liver abscess.

Symptoms.—The symptoms vary according to the size and the location of the cyst. When large and near the surface, it may be felt as a globular tumor, rather elastic and sometimes fluctuating. If the tumor is behind the liver, there may be no symptoms at all. Most patients complain of a sense of distress and weight in the hepatic region. As the tumor grows there may be pressure symptoms, as dyspnea and cough, from extension upward to the diaphragm. Pressure on the portal vein may result in ascites, jaundice, or hemorrhoids. The hydatid fremitus or Santorini's booming sound is seldom present. It is present only when the daughter cysts swim in the fluid.

¹ O'Connor, John: "Clinical Contribution to the Surgery of the Liver." Ann. Surgery, 1897, xxv, 547.

² Fowler, Russell S.: "Tumors of the Liver." Brooklyn Med. Jour., 1900, xiv, 943.

³ Frank, Jacob: "Hydatids of the Liver." Amer. Jour. Med. Sci., 1896, cxii, 437.

Diagnosis.—The diagnosis is often difficult, as many of these patients may remain in good health for years. It may be differentiated from cancer and abscess by the long history, slow growth, the absence of loss of weight, and the lack of the pronounced constitutional symptoms present in abscess. Its shape and absence of biliary symptoms rule out gall-bladder disease. The fact that the colon does not overlie the tumor rules out cystic or sarcomatous kidney.

Treatment.—The treatment consists of evacuation of the cyst contents and removal of the lining of the cyst cavity and drainage of its cavity, or, in a few selected cases in which the cyst is pediculated, excision of the entire cyst.

The operation of drainage of the cyst may be done in two stages after the method of Volkmann, which consists of opening the peritoneal cavity and placing sterile gauze pads between the cyst wall and the peritoneum to cause adhesions to form between the liver and the peritoneum, or suturing the cyst wall to the peritoneum, and three or four days later opening and draining the cyst.

O'Connor¹ has found that the cyst wall is usually so thin that it is impossible to suture it to the peritoneum without leakage of fluid around the stitches.

The operation commonly done consists of making an incision over the most prominent part of the swelling, then, after carefully packing away the stomach and the intestines with sterile gauze pads, a trocar is inserted into the cyst and as much fluid as possible is withdrawn. The cyst is then incised and the remainder of its contents sponged out. The lining of the cyst, which is known as the parasite endocyst, is removed. The edges of the cyst are sutured to the peritoneum and the cyst cavity is packed with gauze. The after-treatment consists in gradually diminishing the amount of packing at each dressing until the cyst cavity is obliterated.

INJURIES OF THE LIVER.

The liver is apt to be injured by crushing accidents, as when a heavy wagon-wheel passes over the body; also by blows or falls breaking one or more ribs, which puncture the liver, or from penetrating wounds.

The symptoms of rupture of the liver are those of internal hemorrhage and severe shock, such as extreme pallor and cold skin, feeble and rapid pulse, and sighing respiration; the abdomen becomes swollen and tympanitic and sometimes there is dullness on percussion from the collection of blood. Often there are vomiting, thirst, and syncope.

Treatment.—The treatment should be directed toward the control of hemorrhage as soon as possible and to prevent the retention of bile in the peritoneal cavity on account of its liability to cause cholemia.

If from the parts involved it is thought that an injury to the liver is in the left lobe, or if it is undetermined, a median incision is indicated.

In wounds of the right lobe a longitudinal incision is made through the outer edge

¹ O'Connor, John: "Clinical Contribution to the Surgery of the Liver," *Ann. Surgery*, 1897, xxv, 547.

of the right rectus abdominis muscle, and then, if found necessary, this may be converted into the "S"-shaped incision, as suggested by Bevan, or into the Robson incision.

Wounds of the liver may be treated by suture, cautery, gauze tampon, or by suturing a piece of sterile gauze down upon the bleeding surface.

In the majority of cases a little pressure by means of a gauze pad for a few minutes will control the hemorrhage. In some cases it may be necessary to make continuous pressure over the bleeding surface. This may be done by suturing a piece

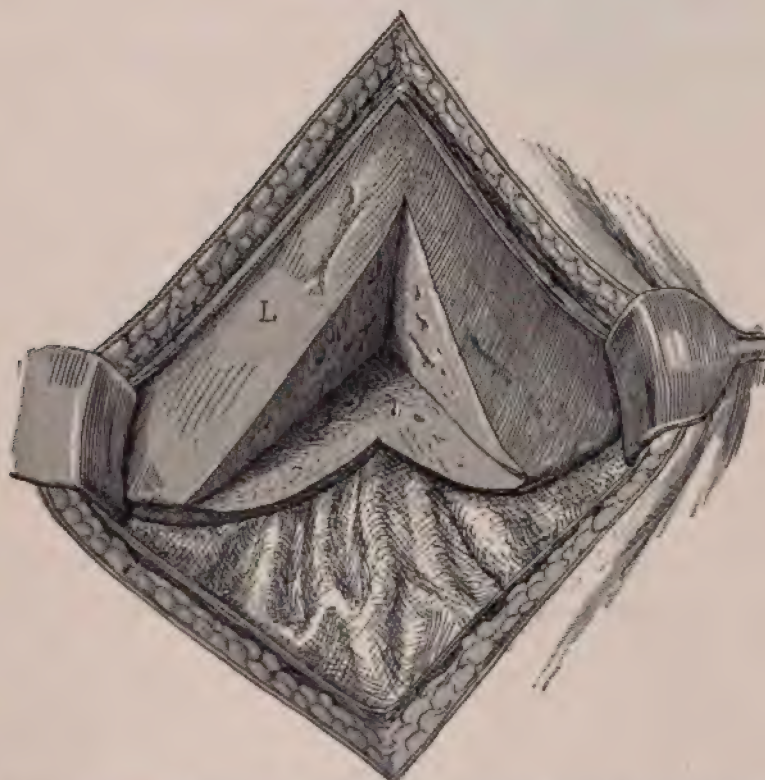


FIG. 559.—SHOWS LIVER AFTER WEDGE-SHAPED PIECE OF LIVER TISSUE HAS BEEN REMOVED (after Jacob Frank).

of iodoform gauze over the bleeding surface by a few catgut stitches and bringing one end up through the abdominal wall. The gauze will make a continuous pressure and the stitches will prevent the displacement of the gauze should the patient cough or vomit.

If an injury is extensive, it is well to pass the catgut sutures entirely through the liver and through a piece of iodoform gauze on the opposite side of this organ in order to prevent cutting of the sutures. The catgut will be absorbed in a few days, so that the gauze may then be readily removed.

In large wounds with considerable destruction of the liver tissue it is better to use

the method of suture devised by Frank.¹ He excises a portion of the liver, as shown in Fig. 559, removing a wedge-shaped piece of liver tissue, leaving the organ with two flaps forming a trough. If there is much bleeding from the liver tissue, it is controlled by ligating the bleeding vessel or by passing a mattress catgut suture through the entire thickness of the liver surrounding the vessel.

For suturing the liver a non-cutting needle should be used. The blunt needle devised by Kousnietzoff, shown in Fig. 560, is very satisfactory. The straight needle should be used in placing mattress sutures and the curved one for ordinary suturing. The flaps are now coaptated. With a long non-cutting needle threaded with catgut a running stitch (Fig. 561) is commenced at one end and continued as follows: One suture is carried through the liver tissue near the bottom of the trough and then one superficially, and so on alternating. It requires but little pressure to control all the bleeding.

Crile has shown that the blood-pressure is very low in the liver and that most

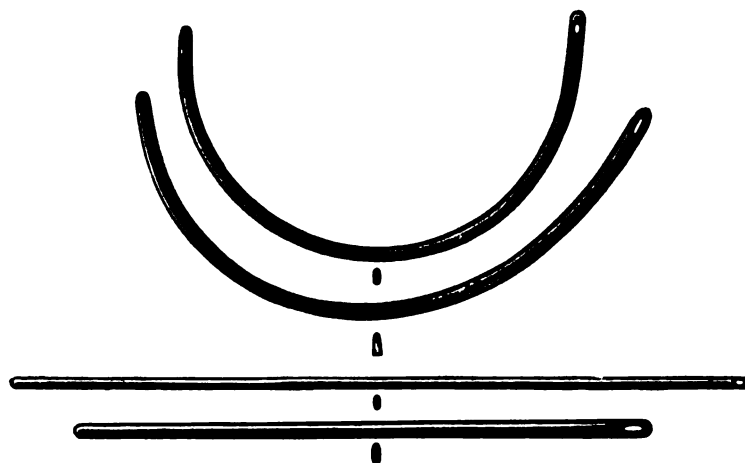


FIG. 560.—KOUSNIETZOFF'S BLUNT NEEDLES FOR SUTURING THE LIVER.

of the bleeding from a cut surface is venous. The main object is to bring the two flaps together in perfect coaptation, obliterating all dead spaces.

The continuity of the liver surface is re-established and no raw area or ragged edge is left.

SUBPHRENIC ABSCESS.

Subphrenic abscess is a localized collection of pus between the under surface of the diaphragm and any of the adjacent abdominal organs. It may be intraperitoneal or extraperitoneal, and the abscess is more frequently found upon the right side.

The most common source of infection is from the extension of a local inflammatory condition. It may also occur as a localization in the subphrenic space of a

¹ Frank, Jacob: "Incising and Suturing the Liver," Jour. Amer. Med. Assoc., 1905, xlv, 446.

general infection, the infectious material being carried to the subphrenic region by the blood-current. Direct extension of an infection of the appendix may be spread upward by two routes, one intraperitoneally along the outer side of the colon to the liver, then between the liver and the diaphragm, or from the loose cellular tissue behind the cecum, then upward behind the colon and liver to the subphrenic space.

Subphrenic abscess may be secondary to disease of the gall-bladder and biliary passages.

Abscess of the liver may, in its late stage, extend beyond the liver to the dia-

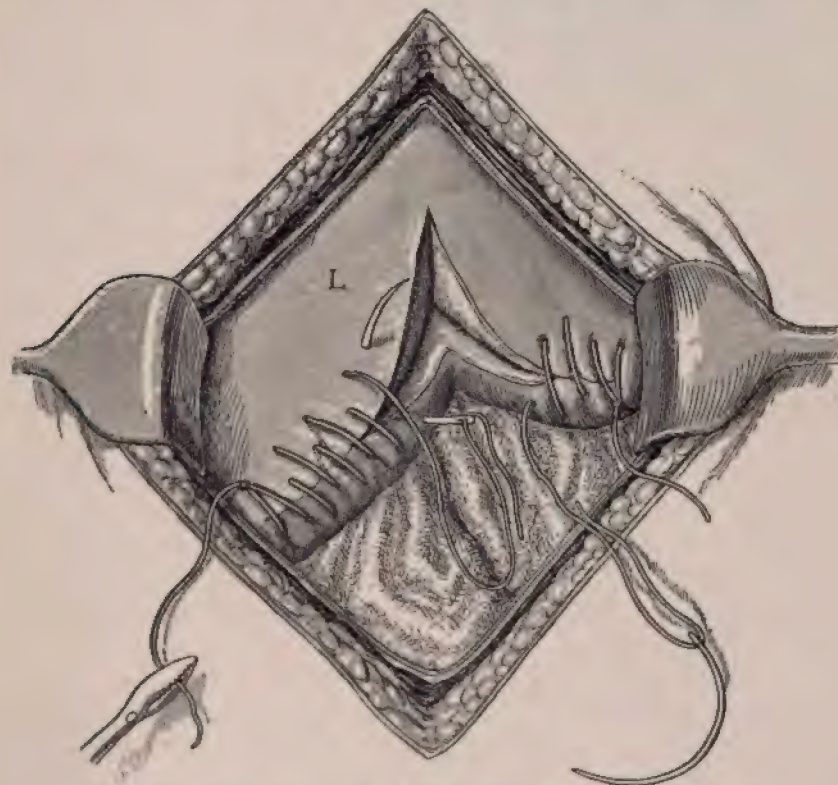


FIG. 561.—SHOWS COAPTATION OF LIVER SURFACES (after Jacob Frank).

phragmatic space. Occasionally the infection comes from a slow perforating ulcer of the stomach or duodenum, or from inflammation of the pancreas, intestines, spleen, or from some of the various suppurative processes of the kidneys.

Subphrenic abscess may follow an empyema of the pleural cavity. In seventy-three cases following appendicitis which Elsberg¹ has collected in the literature, the abscess was extraperitoneal in twenty-three cases, intraperitoneal in thirty-five cases, the anatomic location doubtful in eighteen cases.

Symptoms of subphrenic abscess may come on days, weeks, or months after an appendicitis or any intra-abdominal disease which may lead to it.

¹ Elsberg, Charles A.: "A Contribution to the Pathology, Diagnosis, and Treatment of Subphrenic Abscesses after Appendicitis," *Ann. Surgery*, 1901, xxxiv, 729.

CHAPTER XXXIII.
OPERATIONS UPON THE STOMACH.

BY B. G. A. MOYNIHAN, F. R. C. S.

PREPARATORY TREATMENT AND INVESTIGATION OF THE STOMACH.

It is highly important that the contents of the stomach should be as free from germs as possible at the time when this portion of the digestive tract is to be operated upon. It is to Harvey Cushing that we are indebted for the demonstration that such a condition of asepsis is attainable. His first observations in this direction were upon a man who, as the result of a wound, developed a high jejunal fistula. In this case it was found that there was a marked diminution in the number of the organisms growing in cultures from the fistulous discharge after the patient had been kept for a day or two on a sterile diet; special attention being paid at the same time to the hygiene of the mouth.¹

It has also been shown that after a period of starvation the stomach and upper part of the intestine are practically sterile.

Although these methods may be sufficient when dealing with the healthy individual, there are certain pathologic changes in the stomach, particularly those calling for surgical intervention, where the vegetable flora persist even after starvation. This is especially well seen when the outlet of the stomach is blocked by an ulcerating growth; the organ is unable to empty itself, the secretion of hydrochloric acid is in abeyance, or, if present, in so small a quantity that it is probably neutralized by the albuminous discharges from the surface of the growth. The stagnant contents of such a stomach form a favorable medium in which many species of micro-organisms flourish; and though many of these forms are probably non-parasitic, yet even saprophytes are undesirable as possible invaders of the peritoneum.

Again, the contents of a dilated stomach secondary to a fibrous stricture beyond the pylorus, or to active ulceration in this region associated with an increased acidity of the gastric juice, will be found to contain, even after a period of fasting, other forms of vegetable life, as *saccharomyces* and *sarcinæ*.

Since it is clear that mere abstinence from food, or the administration of only sterile fluid foods, is not always enough to rid the stomach of bacteria, it is necessary to make use of the stomach-tube for the purpose of mechanically washing the stomach.

With a few exceptions, such as cases of cancer of the esophagus or cardiac orifice, perforated ulcer, or one which has recently bled, gastric lavage should be regarded

¹ Cushing, Harvey: "Remarks upon a Case of Jejunal Fistula," *Johns Hopkins Hosp. Bull.*, July, 1899, x, 136.

as the routine preliminary to operative treatment; the advantages lie not only in the direction of antisepsis, but may, from the diagnostic point of view, prove of the utmost value. If the importance of the procedure be clearly explained beforehand, there will be found very few patients who refuse to submit to it; and if the passage of the tube be performed with care and gentleness it is safe to assure the patient that repetition will be less unpleasant than the first procedure. The cases suffering most from gastric lavage are those in which there are adhesions to the under surface of the liver or diaphragm; in these cases there is not likely to be much dilatation or need for washing the stomach.

As of almost equal importance to the washing are to be reckoned the care of the mouth and teeth and the sterilization of the food. A rational combination of these precautions is an essential preliminary to all operations upon the stomach.

The preparatory treatment should begin not less than two days before the operation, while, if the diagnosis needs to be decided by laboratory methods, a longer time may be desirable. The routine treatment is then carried out as follows: As soon as the patient is admitted the stomach-tube is passed and any material in the stomach withdrawn, and labeled "A" and kept for examination, the time and character of the last meal being also noted. The stomach is washed out until the returning fluid is clear, the stomach is finally emptied and then distended with air by means of a rubber syringe; meanwhile the patient is made to lie down with the abdomen uncovered and the shape and size of the stomach carefully observed. An aperient is then given and, the last thing at night, the patient is required to eat a fairly heavy meal consisting of meat, vegetables, etc.; nothing is then taken for about eight to ten hours, when the stomach-tube is again passed, any contents removed and labeled "B," and the stomach again washed clear. At the end of this washing, before the tube is withdrawn, the stomach is filled with water, a saline aperient is administered, and thereafter the patient is allowed nothing but sterilized liquids. On the evening before operation the stomach is again washed out, and the patient then allowed nothing but sterilized water, of which, however, he is encouraged to drink freely. If it is necessary to give the patient a test meal of dry toast and tea, this may be done before the third washing, on the eve of the operation if time presses, but where possible time should be allowed for this not less than twenty-four hours before operation and labeled "C." During this period of preparation the patient must brush his teeth and rinse his mouth with a mildly antiseptic lotion frequently and thoroughly. A few cubic centimeters of the feces should be reserved for examination, and if there is any uncertainty as to the diagnosis, an examination of the blood should be made between one and two hours after the full meal, and again at the end of the eight hours' fast.

It will be seen that while the tube is passed primarily for cleansing purposes, the opportunity it affords for obtaining material to aid or confirm the diagnosis is not neglected. As to the manner in which this material may be utilized: among the many laboratory tests which have been devised for the purpose of differentiating pathologic conditions of the stomach there are a few which may be simply carried

out and from which in their relation with one another certain inferences may be deducted. These investigations are concerned with the presence or absence of food residue, blood, free HCl, lactic acid, yeast, sarcinæ, other micro-organisms, pus, and other cellular elements in the specimens of stomach contents (A. B. C.), the presence or absence of blood in the feces, and the presence or absence of a digestion leukocytosis.

For the proper interpretation of the results of tests of the stomach contents, blood, and feces, it is essential that these results should be viewed in their relation one with another. Few of the tests can stand alone with any diagnostic weight, and then only when the results obtained under different conditions conform to certain rules.

Before considering the deductions which may be drawn from the whole series of different tests upon a given case, it will be advisable, in order to obtain a just estimate of their individual value, to review each test separately.

1. *The Amount of Residue Visible to the Naked Eye in the Stomach Contents.*—If there remains any food in the stomach after a fast of eight hours it may be assumed that there is some impediment to the onward passage of food. If the stomach contains food débris after this lapse of time, and is colored with blood, it is obvious that the bleeding is on the proximal side of the obstruction; but if the stomach contains blood unmixed with the remains of food, there may yet be a perfectly free outlet to the stomach, and the blood may be of gastric or duodenal origin.

2. *The Chemical Test for Blood.*—This, if positive, is of little value alone; traces of blood may be derived from the pharynx, esophagus, stomach, or duodenum. This test is so delicate that traces of blood due to some slight injury in passing the stomach-tube may give rise to error unless a previous specimen of the stools be examined at the same time. The constant recognition of traces of blood in the gastric contents and in the stools is suggestive of either malignant growth in the stomach, or active ulceration in the stomach alone, or in the stomach and duodenum; but it cannot be taken as negating the existence of a duodenal ulcer only.

3. *Lactic Acid.*—The presence or absence of this has very little value in itself. Even when taken in conjunction with other tests it can only be considered of confirmatory importance. In the presence of free HCl it is scarcely necessary to test for it, while it is frequently present in cases of carcinoma if HCl is absent.

4. *Free HCl.*—Of all the tests regarded singly, that for the detection of HCl is perhaps the most valuable. To be reliable, however, it needs to be demonstrated under different conditions. If absent after a fast of eight hours and present one hour after a test meal the stomach may be normal, there may be obstruction in the neighborhood of the pylorus or duodenum due to causes not arising therein, there may be only gastroptosis, or there may be a duodenal ulcer without constriction, or occasionally a gastric ulcer away from the pylorus. If HCl is present in any quantity both after the test meal and after a prolonged abstinence from food, it is probable that there is a pyloric ulcer or a duodenal ulcer with gastrectasis. If HCl is absent on both occasions, or only faintly present after a test meal, it is extremely probable that the patient is suffering from a cancerous growth.

5. Yeast and sarcinæ are found in the stomach after fasting only when there is stasis of food. The presence of a gastric secretion containing HCl appears to be necessary for their occurrence; though this may not be recognized in the contents after an eight hours' fast, yet its presence is to be expected during digestion. Saccharomyces and sarcinæ may occur together, or one or the other may predominate. They will usually be found unaccompanied by any number of other organisms; and if there is stasis in association with achlorhydria, they are rarely met with. Their significance lies in the fact that they develop in the stomach in the presence of free hydrochloric acid when the onward passage of the gastric contents is delayed from any cause.

6. Bacteria are not found in any quantity in the fasting stomach unless the process of digestion is imperfect by reason of a deficiency in the secretion of hydrochloric acid. Short bacilli with rounded ends, diplococci, staphylococci, and streptococci are the most usual forms, but a long slender bacillus may be found with squarely cut ends, often slightly curved, which retains the stain in Gram's method—the *B. geniculatus* or Oppler-Boas bacillus—to which a special interest attaches. The organism has been given pathognomonic value in the diagnosis of cancer of the stomach. Though it is certainly often met with in cases of this disease, yet, in the stomach contents, it is always associated with other forms of bacteria whose presence testifies to the absence or diminution in the secretion of HCl, and, when occurring in any number after an eight hours' fast, suggests pyloric obstruction. It is to be noted that the presence of bacilli, cocci, etc., in the fasting stomach has not the same significance, as regards stasis, as is possessed by the presence of yeast cells and sarcinæ under the same conditions; the irregular surface of a malignant growth may harbor enormous numbers of organisms in its interstices without encroaching upon the outlet of the stomach.

7. *Pus cells* are not often found in any numbers; they are not often to be recognized in cases of simple ulcer, but may be seen where there is an extensive ulcerating growth in the stomach. Large quantities of pus would indicate the evacuation of a perigastric abscess into the stomach.

8. *Epithelial Cells, Fragments of Tissue, etc.*—It is not often that fragments of growth of sufficient size are removed by the stomach-tube to throw any certain light on the diagnosis. Squamous epithelial cells may often be found under the microscope; these have been scraped from the wall of the pharynx or esophagus. It is unusual to meet with red blood-cells unless there has been an evident hemorrhage.

9. Examinations of the blood taken before and after a meal in order to determine the existence of a digestion leukocytosis may be of use in deciding the diagnosis when the question of carcinoma has to be considered. Apart from this, the hemoglobin percentage may be of prognostic importance when considering the propriety of operative interference after severe or repeated hemorrhages, though the safe limit will be fixed in such cases by the individual surgeon's experience. Occasionally the blood examination will be required to decide between a primary anemia and one secondary to continued latent hemorrhages.

10. The *chemical test* for blood applied to the feces will frequently give a positive result both in cases of ulcer and cancer, provided that, in the latter case, the growth has an ulcerated surface. As already stated, the presence of blood in the feces and in the stomach contents points to the existence of an ulcer either in the stomach

alone, or in the stomach and duodenum, or to carcinoma of the stomach, but cannot with certainty rule out duodenal ulcer alone.

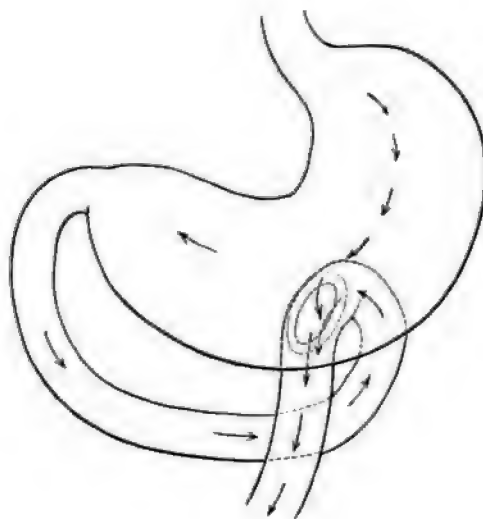


FIG. 562.—ISOPERISTALTIC ANASTOMOSIS.

of "anterior gastro-enterostomy," "posterior gastro-enterostomy," or "inferior gastro-enterostomy." The jejunum may be united to the stomach so that its proximal end is to the left, the peristaltic wave in both stomach and intestine at the anastomosis being from left to right; the anastomosis is then said to be "isoperistaltic" (Fig. 562). If the jejunum is applied to the stomach in the opposite direction, the anastomosis is "antiperistaltic" (Fig. 563).

History.—On September 27, 1881, Wölfler, then assistant to Billroth at Vienna, was operating on a case of carcinoma of the stomach, with the object of resecting the growth. This was found to be impossible, and the abdomen was about to be closed, when Nicoladoni, who assisted Wölfler, suggested that a new opening might be made between the stomach and the small intestine to replace that which was obstructed by the growth. This was done; and in this manner was introduced into surgical procedures an operation which has had perhaps no rival in the

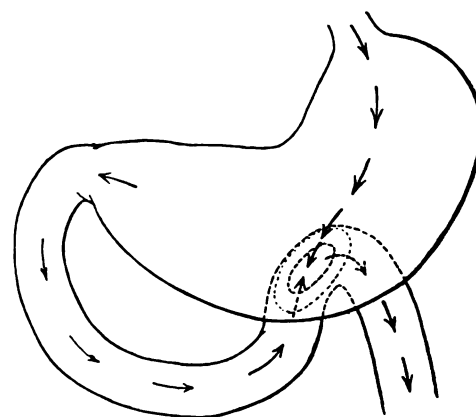


FIG. 563.—ANTIPERISTALTIC ANASTOMOSIS.

excellence of its results, and in the immensity of the relief it has afforded to those doomed to constant suffering or to death.

Wölfler united the jejunum to the anterior surface of the stomach in an antiperistaltic direction. Von Hacker was the first to perform the operation by the posterior method.

Conditions for Which the Operation is Performed.—In cases of ulceration of the stomach:

Gastric Ulcer.—Ulceration of the stomach may be acute or chronic; of the two forms the surgical interest of the latter is by far the greater.

Acute ulcer of the stomach may be found at any part of the stomach, and occurs with great rarity in men. The ulcer is small, round or oval, as though it had been “punched out” from the inner walls of the stomach, and it is often funnel-shaped, being widest at the mucosal surface, narrowing gradually as it penetrates the coats of the stomach.

Chronic ulcer of the stomach is much larger, and occurs more frequently in males. It may be found at any part of the stomach, but in the cases which come to the surgeon it is found more frequently at the pylorus, or on the upper border of the stomach a little away from the pylorus (“prepyloric”), than at other parts.

Fenwick¹ has collected 1015 cases of ulcer of the stomach and gives the following table to show the positions occupied:

	CASES.	PERCENTAGE.
Pylorus	158	15.6
Lesser curvature.....	366	36.0
Posterior surface.....	254	25.0
Cardia.....	80	7.9
Greater curvature.....	42	4.14
Anterior surface.....	82	8.0
Fundus.....	33	3.3

In this table no distinction is made between acute and chronic ulcers. But in his own series of cases a distinction between the two forms is made and a marked difference in their distribution is clearly seen. In 109 cases there were 70 in which a chronic ulcer was found: Of these, 53 were found in the pyloric region, 7 were found in the middle zone, 10 were found in the cardiac zone. Of the 39 acute ulcers, 13 were found in the pyloric region, 14 were found in the middle zone, 12 were found in the cardiac zone. Acute ulceration therefore shows no special incidence in any part of the stomach, while in chronic ulcer there is a pronounced partiality for the pyloric region.

So far as sex incidence is concerned there can be no question that acute ulceration is more common in women, especially young women, and that chronic ulceration is more prevalent in men. The following table, showing age and sex incidence in 89 cases observed by Fenwick, is given in his book:

¹ Fenwick, Samuel, and W. Soltau Fenwick: “Ulcer of the Stomach and Duodenum and its Consequences,” 1900, pp. 7, 8.

EIGHTY-NINE CASES OF OPEN ULCER, ARRANGED ACCORDING TO THE CHARACTER OF THE DISEASE AND AGE OF THE PATIENT AT THE TIME OF DEATH.

AGE.	ACUTE ULCERS.		CHRONIC ULCERS.	
	Males.	Females.	Males.	Females.
10-20.....	1	7	..	1
20-30.....	1	13	1	2
30-40.....	1	7	5	3
40-50.....	..	..	22	6
50-60.....	..	..	8	4
60-70.....	..	..	6	..
70-80.....	..	..	1	..
Total.....	3	27	43	16

No age is exempt from this affection. Children may be born with ulceration of the stomach or duodenum, and death from perforation has been recorded by Porter Parkinson in a child of two. I have myself seen duodenal ulcer attended by very serious hemorrhage in an infant. The statistics of Fenwick, to which frequent reference has been made, show that while 75 per cent. of cases of gastric ulcer in women are found before the age of thirty, only 25 per cent. are found before that age in men. It is shown, moreover, that of acute ulcers over 70 per cent. occur within the first three decades of life, while of chronic ulcer less than 7 per cent. occur within that period.

Symptoms.—The symptoms and signs of gastric ulceration are of such a kind that in the majority of cases a clear unhesitating diagnosis can be given. But there are cases in which diseases in other parts, the duodenum, the gall-bladder, or the appendix, may cause an exact mimicry of the clinical appearances of gastric ulcer, and there are cases of the so-called "functional" diseases of the stomach that are with difficulty distinguished from those in which organic disease is present. But the more exact the anamnesis and the more thorough the investigation, upon the lines already laid down in the opening chapter, the less frequently will these difficulties be encountered. The chief of the symptoms and signs of chronic gastric ulcer are:

Pain.—Pain after food is the most constant and the most reliable of all the symptoms. In my own experience where exact observations have been made there is a definite relationship between the time of the onset of pain after a meal and the position of an ulcer in the stomach. From two patients I heard a complaint that pain came almost the moment food had reached the stomach; in both the ulcer was almost at the cardiac orifice. If pain comes one and one-half hours after food, the ulcer is prepyloric or pyloric. The researches of Birmingham into the anatomy of the stomach explain why it is that there should be this relationship between the taking of food and the onset of pain. He has shown¹ that the stomach is not an

¹ Birmingham, A.: "The Topographical Anatomy of the Spleen, Pancreas, Duodenum, Kidneys, etc.," Jour. Anat. and Phys., 1896, xxvi, new series vi, p. 95.

empty sac, to the bottom of which fluid falls, but a contractile muscular organ that fills at the cardiac end first, and little by little passes the food onward through the pyloric antrum and pylorus into the duodenum. Food does not come in contact with an ulcer a little distant from the pylorus until it has lain in the stomach for a certain time. Pain is often acute, radiating to one or other side, or penetrating to the back. When the pain radiates upward to the left or right breast it indicates the existence of adhesions to the diaphragm or the under surface of the liver. In pyloric or duodenal ulcer the pain is relieved by the food for a time; for after ingestion of food the pyloric antrum and pylorus are closed, and an ulcer therein is free from the irritating contact with passing food.

Tenderness is generally present in cases where there is any acute exacerbation of a chronic process. Mackenzie, of Burnley, has endeavored to show that there is a relationship between the local tenderness and the position of an ulcer. If the tenderness is high up near the ensiform cartilage and a little to the left of the middle line, a cardiac ulcer may be suspected; if there is tenderness low down near the umbilicus, the pyloric region is likely to be involved.

Vomiting is not a frequent and rarely a conspicuous sign of gastric ulcer. This statement, which is contrary to that generally given, is hardly open to question, so far as my own experience goes. The reason is that patients by degrees come to recognize what will and what will not cause pain or a feeling of sickness, and they avoid that quantity or that quality of food. It may be said that they take the measure of their stomachs' capacity, and they keep within the limit of its powers. Even in cases where an extreme degree of stenosis has been disclosed at the operation the patient will say that he has "never vomited." But if such a patient be made to transgress his own limitations, sickness and vomiting may be provoked at once. In the earlier stages of the disease vomiting may occur, perhaps frequently, and blood may be mixed with the ejected material, or blood may be vomited alone, in small or in very large quantities. Blood may be found in the stools even when there has been no vomiting at all; this I have more than once observed. Melena is a sign doubtless often overlooked.

Dilatation of the Stomach.—This term, which is so widely used and accepted, is unfortunate, for mere bigness of the stomach means nothing. There is as much (nay, far more) variation in the size of stomachs as in the size of noses. It is not size, but *capacity for emptying* itself, which is the important point. A stomach may be of any size, within reasonable limits, so that every one would acknowledge it to be a "dilated stomach"; but if it empties itself of food within six or eight hours, it is performing its proper function just as well as if it were half the size. Stasis of food of over ten hours' duration indicates always, in my view, a pathologic condition. If stasis is of long duration as the result of obstruction, then hypertrophy of the muscular coats of the stomach, more especially in the pyloric half, is noticed. In a well-marked case of this kind constant waves of contraction can be seen to pass from left to right across the front of the abdomen; and inflation with CO₂ will often elicit these when otherwise they are not evident. In long-standing cases of pyloric

obstruction the patient may vomit, after three or four days, food which has lain stagnant all that time in the stomach.

Indications for the Performance of Gastro-enterostomy.—(A) The following are the conditions in cases of *gastric ulcer* which call for treatment by gastro-enterostomy:

1. When perforation has occurred in an ulcer so situated that the closure of the opening narrows the outlet of the stomach, *e. g.*, in pyloric ulcer or in duodenal.

2. When perforation has occurred in an ulcer in the stomach and a second ulcer near the pylorus or in the duodenum is seen. (In one of my cases death occurred from the perforation of a duodenal ulcer eleven days after the closure of a gastric perforation.)

3. When hemorrhage is occurring from a duodenal or gastric ulcer in such quantities as to threaten the life of the patient. In such circumstances the hemorrhage usually occurs in increasing quantity at decreasing intervals.

4. When inveterate dyspepsia is caused by a chronic ulcer of the stomach which medical treatment has not sufficed to heal.

5. When an inflammatory tumor of the stomach or pylorus results from the induration and thickening around an ulcer.

5. When perigastritis with adhesions secondary to ulcer or other complications (cholecysto-gastric or duodenal fistula) is interfering with the proper action of the stomach.

7. When an ulcer in its cicatrization has caused a narrowing in the body of the stomach (hour-glass stomach) or at the pylorus (pyloric stenosis), with consecutive dilatation and hypertrophy of the stomach behind the obstruction, and stasis of the stomach contents.

8. When a duodenal ulcer has been diagnosed with certainty, and its symptoms have not rapidly receded under treatment. Medical treatment is of extremely little value in cases of duodenal ulcer, owing to the mechanical conditions present. Personally I advise surgical treatment for duodenal ulcer as soon as the diagnosis is assured.

(B) *In cases of corrosion of the gastric mucosa by acids or alkalis, or other irritants.*—When an acid or an alkali, carbolic acid, soap lyes, or the like, are swallowed by accident or with suicidal intent the stress of the caustic effect may fall upon the mouth, pharynx, esophagus, or stomach. If the stomach is chiefly affected it is always the pyloric portion which suffers most. The mucous membrane there is then thin, purple, and easily stripped away. From the outside the pyloric portion of the stomach resembles a solid cylinder, being hard, contracted, and inexpandible. The symptoms produced by this condition are pain on any attempt at feeding, and incessant vomiting. In such circumstances gastro-enterostomy alone may be performed, or, as is better, gastro-enterostomy combined with gastrostomy, a tube being passed into the distal limb of the jejunum, and the patient being fed entirely through this for a few weeks.

(C) *In Cases of Congenital (or Infantile) Hypertrophic Stenosis of the Pylorus.*—In the year 1788, as Osler¹ has reminded us, Beardsley, of New Haven, Connecticut, described the first case ever observed of this disease. He wrote: "The pylorus was invested with a hard compact substance or scirrhusity which so completely obstructed the passage into the duodenum as to admit with the greatest difficulty the finest probe." In 1841 Williamson² recorded the second case, which occurred in a child who died at the age of five weeks. In 1842 Dawosky³ related a third case. It was not, however, till Hirschsprung⁴ recorded two cases that renewed attention was called to the disease. In recent years Thomson,⁵ and Cautley and Dent⁶ have made important contributions to our knowledge.

The symptoms are these: A child, normal at birth, within a few days, as a rule, but sometimes not till the lapse of a few weeks, begins to vomit, in quantities which gradually increase; the act of vomiting is forcible, food being ejected two or three feet from the patient. Little by little loss of flesh is remarked, until the child becomes wasted to an extreme degree. Constipation is always present, and is due to an absence of food in proper quantity in the stomach. When the abdomen is examined a dilated and contracting stomach can often be seen, and a tumor can be felt at the pylorus. It is this tumor which is the cause of the stenosis at the outlet of the stomach. When examined it is found to be firm, cylindric, solid. On inspection from the duodenal side the mass projects into the lumen of the bowel, presenting an appearance constantly likened to that of the cervix uteri. The tumor is due to a hyperplasia of the circular muscular fibers. In rare cases there has been a hypertrophy of the longitudinal fibers also; in all cases there are numerous long folds of mucous membrane. The etiology of this disease is obscure.

Various forms of operative treatment have been suggested: pylorotomy, pyloroplasty, and gastro-enterostomy. The latter is perhaps the most satisfactory of all methods, though pyloroplasty in the hands of Clinton Dent has yielded admirable results. The medicinal treatment of this condition, however, is not to be neglected. There is good evidence to show that by careful attention to the details of medical treatment, careful dieting, and gastric lavage, surgical treatment is very rarely necessary.⁷

According to Scudder and Quinby,⁸ gastro-enterostomy has been performed

¹ Osler, Wm.: Address: "On the Educational Value of the Med. Society," Bost. Med. and Surg. Jour., March 12, 1903, cxlviii, No. 11, p. 275.

² Williamson, Thomas: "Case of Scirrhus of the Stomach, Probably Congenital; with Remarks," London and Edinburgh Monthly Jour. of Med. Sci., Jan., 1841, No. 1, p. 23.

³ Dawosky, Simon: "Alteration de l'estomac chez un nouveau-ne," Arch. Gen. de Méd., Mai, 1843, 4^e Série, Tome ii, p. 93.

⁴ Hirschsprung: "Fälle von angeborener Pylorusstenose, beobachtet bei Säuglingen," Jahrb. f. Kinderheilk., N. F., 1888, xxviii, 61.

⁵ Thomson, John: "On Congenital Spasm (Congenital Hypertrophy and Stenosis of the Pylorus)," Scottish Med. and Surg. Jour., 1897, i, 511.

⁶ Cautley, E., and Dent, C. T.: "Congenital Hypertrophic Stenosis of the Pylorus," Trans. Roy. Med. Chir. Soc., lxxxvi (second series, lxxviii), 1903, 471.

⁷ Still, Geo. F.: "On the Diagnosis and Treatment of Hypertrophy of the Pylorus in Infants," Lancet, March 11, 1905, i, 632. Sutherland, G. A.: "The Medical Treatment of Congenital Pyloric Stenosis," Lancet, Mar. 16, 1907, p. 725.

⁸ Scudder, Charles L., and Quinby, Wm. C.: "Stenosis of the Pylorus in Infancy," Jour. Amer. Med. Assoc., 1905, xlv, 1665.

forty times, with twenty-one recoveries. The first successful case was performed on a child ten weeks old, in July, 1898. The patient at the age of six was "quite well and fully developed both bodily and mentally."¹ The first four successful cases are still alive and well (Paterson). A very interesting discussion upon this subject is published in the "British Medical Journal," 1906, ii, 939. In performing these operations upon such small children it is important not to make a larger incision than is really necessary,—two inches is ample, as a rule,—and to take pains to suture the abdominal wound carefully by through-and-through sutures of silkworm-gut or silver wire.

(D) *In Carcinoma of the Pyloric Part of the Stomach or of the Duodenum.*—The rôle of gastro-enterostomy in cases of cancer of the stomach is one about which all surgeons are not agreed. The indication upon which I act is this: if the growth is causing any obstruction to the onward passage of food, or if the growth in its increase seems likely to obstruct, then a short-circuiting operation is indicated. But this indication holds good only when the extent of the disease, or the presence of secondary deposits in the liver or elsewhere, or the firm adhesion of the growth to the pancreas or other part, makes the removal of the growth impossible; or when though the growth is removable the condition of the patient is such that an operation of this character would almost certainly be fatal. In cases of cancer of the stomach gastrectomy should be performed if possible; but unhappily the number of cases in which this can be done is comparatively small. There are not a few patients who are so terribly emaciated, though the disease has not passed beyond the stomach itself, that a removal of the growth would be fatal, almost certainly. In such instances gastro-enterostomy may be performed first, the anastomosis being made wide of the disease, and the patient fed while on the table through a stomach-tube passed from the stomach by the new opening into the jejunum. Two or more pints of peptonized milk are given in this way, and the patient may then be invigorated sufficiently to allow the gastrectomy to be performed at once. Or the major operation may be postponed for three weeks; during this time food may be taken in abundance, and a gain in weight of almost a pound a day recorded. I have never, personally, found any difficulty in then persuading a patient to undergo the more serious operation of removal of the growth.

It is no less important to state the contraindications of gastro-enterostomy. This operation is of no value in cases of atonic dilatation of the stomach; it gives no relief to those who suffer from "sensitive stomachs," the nervous dyspeptic women, or the hypochondriacs; it does not lessen the discomforts due to prolapse of the stomach. It is of value only in cases of organic disease; the patient who suffers from "functional dyspepsia" is not a proper patient for surgical treatment.

I have occasionally been asked to operate upon patients, always of the female sex, who have made long and piteous complaints of stomach troubles. Such cases are perhaps handed over for operation after several "cures" by medical treatment. When the abdomen is opened, no organic lesion of any kind is discoverable, neither

¹ Paterson, H. J.: "Gastric Surgery," 1906, p. 92.

in the alimentary tract (stomach, duodenum, appendix) nor in the gall-bladder. In such cases there is no indication for the operation of gastro-enterostomy. Its performance in these circumstances can only bring discredit on the operation. I do not believe in gastro-enterostomy for the relief of symptoms dependent upon no visible disease. And I frankly disbelieve in the ulcer of the stomach or duodenum that cannot be seen or felt, and demonstrated to the onlooker. Invisible and impalpable gastric ulcers, as a cause of symptoms, are a myth.

THE OPERATION OF GASTRO-ENTEROSTOMY.

Preparation of the Patient.—No insignificant part of the success of this operation, or of any of the operations upon the stomach, depends upon the details of the preparation of the patient in the few days preceding the actual operation. The chief of the details of preparation is concerned with the attempt to render sterile the mouth, the stomach, and the jejunum. In a very large proportion of the patients who come to operation for chronic ulcer of the stomach or duodenum a very defective condition of the teeth is noticeable; and it is by no means improbable that the septic material from such teeth, swallowed constantly by the patient, is an important factor in the causation of the ulcer. The most scrupulous attention to the toilet of the mouth must be started as soon as the patient is admitted to the hospital. If the teeth are very bad, it may be necessary to have one or more extracted, and others stopped. The patient should be told to brush the teeth with some fragrant antiseptic wash very frequently. The nurse is instructed to see that such attentions are satisfactory. All nourishment given before the operation should be fluid and sterile. An aperient is given a few days before the operation, and an enema or two, or more, may be necessary to secure the complete emptying of the large intestine.

Many patients who have chronic gastric disease suffer from constipation, and it is no easy matter then to get the large intestine empty of all scybalous masses. To do so, however, is important, for the comfort of the patient is thereby greatly increased for the few days subsequent to the operation. The stomach is washed out as often as is necessary to insure its cleanliness. In ordinary cases once or twice is sufficient, but there are cases of greatly dilated stomach in which the food has been stagnant which are not to be cleansed so easily. The lavage should be copious, hot saline solution being used. It is only when hemorrhage has recently occurred that great care is necessary in the process; if there has been recent severe hemorrhage I do not wash the stomach out at all, or do so only very gently, just before the operation. In cases where the stomach is very foul, it is useful to administer isoform in dose of 8 grains thrice daily.

The following methods of gastro-enterostomy will be described: (A) Posterior gastro-enterostomy; (B) anterior gastro-enterostomy; (C) Roux's operation.

Posterior Gastro-enterostomy.—*Technic of the Operation.*—An incision about 4 to 5 inches in length is made three-fourths of an inch to the right of the

middle line, and the anterior sheath of the rectus opened. The fibers of the rectus muscle are then split from top to bottom, by first gently separating them at the tendinous intersection toward the upper end of the wound, and then extending this separation downward. A vessel to the lower end of the wound, a little above the umbilicus, may require a ligature. The posterior sheath of the rectus and the peritoneum are incised together and the abdominal cavity opened. As soon as this is done a sterilized cloth or handkerchief (the "tetra" material is the best) is applied on each side of the wound and clipped above and below so that the skin is neither seen nor touched in any of the subsequent manipulations. A general inspection of the stomach, duodenum, and gall-bladder is first made, and if the patient is thin and well-anesthetized there is no difficulty in this. The presence of ulcer, adhesion,

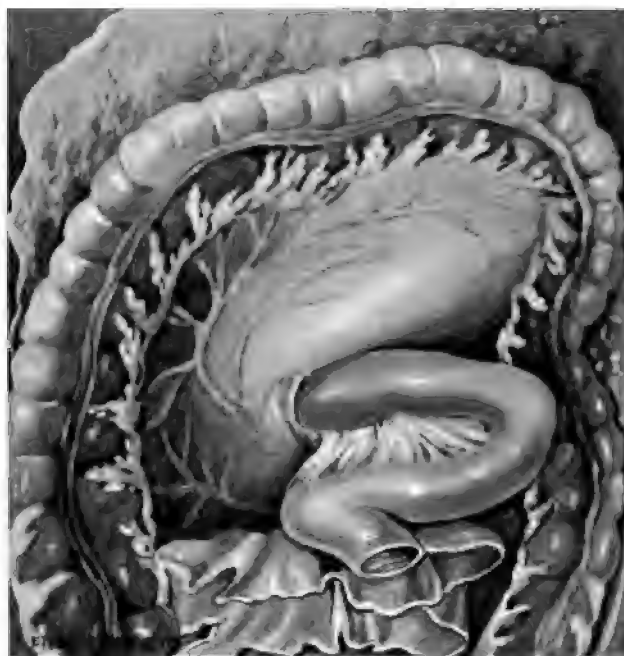


FIG. 564.—SHOWING JEJUNUM GOING TO THE LEFT.

growth, etc., is noticed, the position of parts, and their mutual relationships. The hand is then passed into the wound and a very careful examination made of the whole of the stomach from cardia to duodenum. The need for this advice is illustrated by the not infrequent cases where hour-glass stomach has been overlooked. I have recently operated upon a man whose abdomen had been opened by a most distinguished surgeon three months before, and closed again, as there was "nothing wrong with the stomach." This was true, but there was a large duodenal

ulcer with a cystoduodenal fistula which had been overlooked. The inspection and the manual examination must be done thoroughly, but quickly. When it has been decided to perform gastro-enterostomy, the great omentum and the transverse colon are turned upward out of the wound, until the under surface of the transverse mesocolon is exposed. At this stage, before anything further is touched, the surgeon must inspect the duodenojejunal flexure in order to see the direction which is taken by the first few inches of the jejunum as it leaves the flexure. It will be found that this varies considerably. In rather more than half the cases (as my figures show at present) the jejunum passes outward to the left, along the lower border of the pancreas, horizontally or slightly downward to the hollow below

the kidney (Fig. 564). In other cases the gut passes almost vertically downward (Fig. 565); in still other cases downward and to the right in the direction of the appendix (Fig. 566). Whatever the direction is, it must be carefully and accurately noted, for the intention is that *the natural direction of the jejunum should remain after the completion of the anastomosis*. For example, it is not desirable, when the jejunum passes to the left, that it should be fixed along a line on the stomach drawn downward and to the right, and it is



FIG. 566.—SHOWING JEJUNUM GOING TO THE RIGHT.



FIG. 565.—SHOWING JEJUNUM DESCENDING VERTICALLY.

equally undesirable that a jejunum whose direction is toward the appendix should be attached to the stomach along a line drawn downward and to the left. One of these faults is as serious as the other.

The jejunal direction being carefully noted, the transverse mesocolon is divided at a spot devoid of vessels close to the duodenojejunal flexure. The opening so made into the lesser sac of the peritoneum is rapidly enlarged to a sufficient degree, and the posterior surface of the stomach thus exposed is drawn through the opening (Fig. 567). It is important to select the proper part of the stomach for the

anastomosis. This is approximately at the junction of the cardiac two-thirds with the pyloric third, at the most dependent part of the greater curvature. The next step is to determine the direction of the line on the stomach along which the anastomosis with the jejunum has to be made. If the jejunum has been found to pass to the left along the lower border of the pancreas, the line upon the stomach should run obliquely from above downward and to the left; the line, that is to say, corresponds with that of the normal direction of the jejunum. If the jejunum has been



FIG. 307. ANTERIOR GASTRO-ENTEROSTOMY; OPENING IN MESOCOLON.

run obliquely downward and to the right toward the appendix, then the line upon the stomach should run obliquely from above downward and to the right. Between these two extremes any direction may be taken upon the stomach to correspond with the normal line.

As soon as the direction of the line of anastomosis has been determined upon, a clamp is applied to the stomach in such manner as to make sure that this line is embraced by the clamps. A second clamp is then applied to the jejunum as high up as possible so that when the operation is completed the opening between the jejunum

and the stomach shall begin about $1\frac{1}{2}$ inches below the duodenojejunal flexure. In place of the two clamps I now generally use a single three-bladed clamp (Fig. 568), which is, on the whole, rather more convenient. The original three-bladed clamp was suggested by Roosevelt, and it is after his model that my instrument was made.

All the viscera except those parts of the stomach and jejunum engaged in the clamp are returned within the abdomen and covered with hot moist swabs. The swabs are packed closely around the clamp on all sides. The sutures are now introduced. There is an outer sero-muscular suture of fine linen thread, and an inner suture which includes all the coats of both viscera, also of linen thread, or, if it is preferred, of catgut. The outer suture is first introduced. It commences at the part of the stomach and intestine furthest from the operator, and is carried toward him for a distance of $2\frac{1}{2}$ inches at least, until the end of the clamp nearest him is reached. The interval between the individual insertions of this continuous suture are about one-eighth of an inch and the stitch all along is pulled fairly tight (Fig. 569). As each passage of the needle through jejunum and stomach is completed the suture is pulled upon gently, so that, at the same time, the thread just introduced is tightened and a little ridge or fold of each viscus is raised up, making clear the exact position for the passage of the needle next time. When the first row of the stitch is complete, the needle is laid aside, to be used again at a later stage of the operation. In front of this row an incision is now made into the stomach and jejunum, the serous and muscular layers of each being carefully divided until the mucous membrane is reached. As the cut is made the serous coat retracts and mucous layer pouts into the incision. The cut edge of the serous coat is loosened all around from the underlying mucosa. An ellipse of the mucous membrane is now excised from both stomach and jejunum, the portion removed being about $1\frac{3}{4}$ to $2\frac{1}{2}$ inches in length, and rather more than half an inch in breadth at the center. The gastric mucosa shows a marked tendency to retract; it is, therefore, seized with a pair of miniature (French) vulsella forceps on each side. No vessels are ligated, as a rule. The cut surface of the bowel and



FIG. 568.—MOYNIHAN'S MODIFICATION OF ROOSEVELT'S CLAMP.

stomach may occasionally ooze slightly; this can be checked at once by tightening the clamps one notch. An Allis forceps is placed on the posterior cut edges of the incision, picking up the mucous and serous coats of the stomach and jejunum. It is placed at or near the end of the incision, near the operator, and is allowed to hang down. Its weight is sufficient to keep the cut edges now to be sutured in apposition and to make them fairly taut. The inner suture is now introduced. It embraces all the coats of the stomach and jejunum around the whole circumference of the opening. The needle is first passed through the



FIG. 569.—POSTERIOR GASTRO-ENTEROSTOMY.

Posterior row of outer sutures introduced, stomach being incised.

wall of the jejunum, from the mucous to the serous surface at the left end of the incisions, and then from the serous to the mucous surface of the stomach at a corresponding point; the knot, when tied, is on the mucous surface. The needle is now passed, time after time, from the mucosa of the jejunum to the mucosa of the stomach, picking up both serous coats in its passage. The stitch is drawn tight enough to constrict any vessels in the cut edges, and as it is so drawn the point for the next introduction of the needle is made clear (Fig. 570). When the stitch has been completed along the hinder margin of the incision, it is returned along the anterior margin (Fig. 571), without interruption until the original end of the stitch, left long, is

reached, when a triple knot is tied, and the ends of the suture are cut short.

The clamps are now removed from both stomach and jejunum; the parts are wiped over with hot moist swabs, and all instruments used up to this point are discarded. This is done on the assumption that the mucous membranes of the two viscera may contain micro-organisms. As a matter of fact, organisms are almost invariably absent, if the plan of preparation of the patient, elsewhere described, is followed.

The original serous suture is now continued (Fig. 572). The needle which was laid aside is used again. The only difficult part of the stitch is now encountered, for there are many vessels along the greater curvature of the stomach and near it which have to be avoided, and unless the utmost exactness is observed, a vessel may easily be wounded. If it should be, a deeper and wider stitch must be passed, and tied with sufficient firmness to check the bleeding. The suture is drawn upon with moderate firmness, with the result that the place for the next introduction of the needle is made plain. When the stitch has been carried around to the point from which it originally started, the end of the thread left long is taken in the fingers; with it the stomach and jejunum are dragged gently upward, and beyond it the needle is passed once before being tied.

The stomach and jejunum are now gently wiped over with a hot moist swab, and the swabs packed round the gut are removed. All that remains to be done now is to suture the edges of the opening in the transverse mesocolon to the bowel. This is done by pulling gently on the jejunum and the stomach, and attaching a clip to the cut edge of the mesocolon, so as to insure that accurate apposition is obtained. A needle then picks up the mesocolon a little from the cut edge, and is then passed through the stomach and jejunum at the line of the anastomosis. When the suture it carries is tied the cut edge of the mesocolon will be rolled inward toward the lesser sac, so that only a smooth edge is left at the suture line (Fig. 573). Three or more similar sutures are passed on the other side of the anastomosis and below it, and the gut wiped and returned within the abdomen. If a pyloric or duodenal ulcer has been exposed, it is wiser to infold it, so as to prevent any chance of hemorrhage, and to secure the more rapid healing of the ulcer.

The abdominal wall is then closed, layer by layer, by suture in the usual manner.

After-treatment.—As soon as the patient is returned to bed he is propped up



FIG. 570.—POSTERIOR GASTRO-ENTEROSTOMY.
Posterior row of inner through-and-through sutures introduced.

almost in a sitting position with a bed-rest or five pillows. This position is sometimes difficult to continue, because the patient shows a persistent tendency to slip down in the bed. A pillow is placed beneath the knees; or a special cushion, suggested by Cairns Forsyth, which is placed beneath the thighs and tied by a strong tape at each end to the head of the bed, will be found useful.

As a rule, the patient does not vomit at all, or if in the act of vomiting the stomach is emptied it is through the new opening into the jejunum that the fluids pass and not out of the esophagus. These patients vomit less than those operated upon

for any other abdominal complaint. For two or three hours nothing is given by the mouth, but an occasional flushing of the mouth with water or tea may be allowed. When the patient desires to drink he is permitted to do so, a cup of tea or a drink of water being given. There is no stint in the quantity of fluids; the patient's desires are allowed to control the supply of liquids given. In the majority of cases no sedative is necessary, but if the patient is suffering pain, a hypodermic injection of $\frac{1}{4}$ gr. of morphin is quite sufficient to afford relief, and to insure a few hours' rest. Whenever morphin is given a turpentine enema is administered twelve hours after, for otherwise flatulence may be troublesome. For a week nothing but fluids are allowed; then milk puddings,

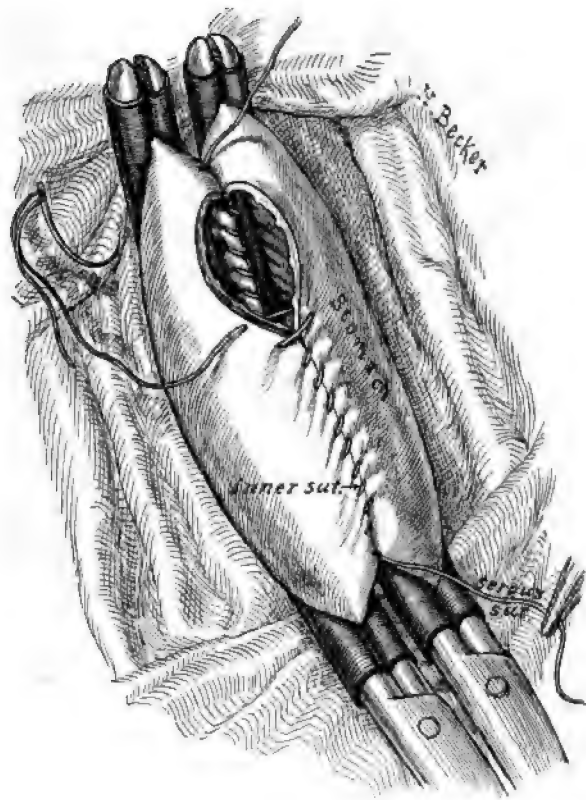


FIG. 571.—POSTERIOR GASTRO-ENTEROSTOMY.
Inner row of sutures continued around the opening.

custard, bread and butter, etc. I never persuade a patient to take solid food, waiting always until he complains of an unsatisfied appetite. Throughout, a very careful toilet of the mouth is observed, and a simple aperient enema is given every twenty-four hours. On the eighth day the patient is allowed to sit up, after the wound has healed, but before the deep stitches are removed. These are taken out about the twelfth day.

(B) Anterior Gastro-enterostomy.—In certain exceptional cases it is necessary to perform the anterior operation. The indications for the preference of the anterior method are: the existence of adhesions between the posterior surface of

the stomach and the pancreas, the invasion by growth of the posterior surface or of the transverse mesocolon, shortness of the mesocolon, etc. There are many surgeons who prefer the anterior operation in all cases of carcinoma, but I personally prefer the posterior method in all cases where it is mechanically possible.

The abdomen is opened in the manner described above through the right rectus muscle. As soon as the stomach is exposed, the anterior wall of it is gripped in a clamp, in such manner that the fold so inclosed runs obliquely on the surface of the stomach from the lowest point on the greater curvature upward and to the left toward the fundus of the stomach and the cardia. A good fold, at least three inches in length, is so grasped.

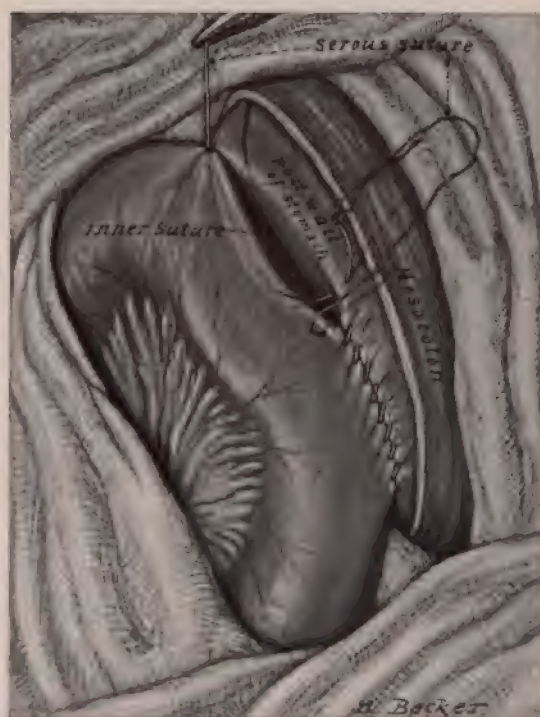


FIG. 572.—POSTERIOR GASTRO-ENTEROSTOMY.
Serosal suture continued.



FIG. 573.—POSTERIOR GASTRO-ENTEROSTOMY.
Suturing the mesocolon to anastomosis.
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The jejunum is then sought, by lifting up the transverse colon and the omentum and defining the uppermost part at the duodenojejunal flexure. A point about 15 to 18 inches below the flexure is then embraced in a second clamp, or in the other half of a three-bladed clamp. The two clamps are then placed side by side in such manner that the highest part of the stomach fold is applied to the highest part of the jejunum.

The viscera are now surrounded with gauze, as in the posterior operation, and the sutures are inserted. The method of their introduction is precisely the same as in the posterior operation, except that the outer layer is made to inclose a longer area than the inner, so that at the upper end of the apposed surfaces there is no opening. When the jejunum is fixed to the stomach it is desirable to make its attachment extend well above the opening, so that there is no likelihood of a kink in the gut at the upper end. This is simpler and more certain than the insertion

of suspension sutures. The outer row of sutures extends generally over a length of 3 inches; the opening, 2 inches in length, is kept to the lower end (Fig. 574).

In some cases of anterior gastro-enterostomy it is necessary to make an entero-anastomosis between the afferent and efferent limbs of the jejunal loop. Many surgeons perform this as a routine; though it adds much to the time of the operation and perhaps something to its risk.

(C) **Roux's Operation.**—Roux, of Lausanne, has introduced a most ingenious method of gastro-enterostomy; the gastro-enterostomy in Y he calls it, which reproduces as nearly as possible the normal conditions in the duodenum.



FIG. 574.—ANTERIOR GASTRO-ENTEROSTOMY.

The extension of the outer row of sutures well beyond the upper limit of the opening is seen.

The jejunum high up is divided completely across, the distal end is inserted into the stomach, and the proximal end into the side of the distal about three inches below the anastomosis. The new opening then represents the pylorus, and the opening of the proximal limb into the distal represents the opening of the common bile-duct and pancreatic duct into the duodenum. Though ideally perfect, this operation in practice has many disadvantages, the chief of which is that it takes forty-five minutes to perform, as there are two anastomotic openings to make.

The operation is performed in the following way: The stomach-wall is clamped as in the ordinary operation. A long loop of jejunum is then picked up, and its base is secured by a clamp. At least 8 to 9 inches should be the length of the loop whose base the clamp holds. The loop embraced by the clamp is now divided about 2 inches from the upper clamped end, the cut being extended into the mesentery (Fig. 575). The upper cut end of the jejunum is now united to the side of the lower part, just above the place where it is clamped; the union is effected in the ordinary manner by suture. The distal cut end is then united to the stomach as it is held by the other clamp. The anastomoses are both completed before either clamp is removed. There is consequently no soiling of the operation field by gastric or intestinal discharges or by blood (Fig. 576).

In the performance of these several operations many surgeons still use the Murphy button, the bone bobbin, the McGraw elastic ligature, etc. Such aids to surgery are no longer necessary. With practice the operation is performed as quickly without them as with them. From every point of view their use at the present day is to be deprecated.

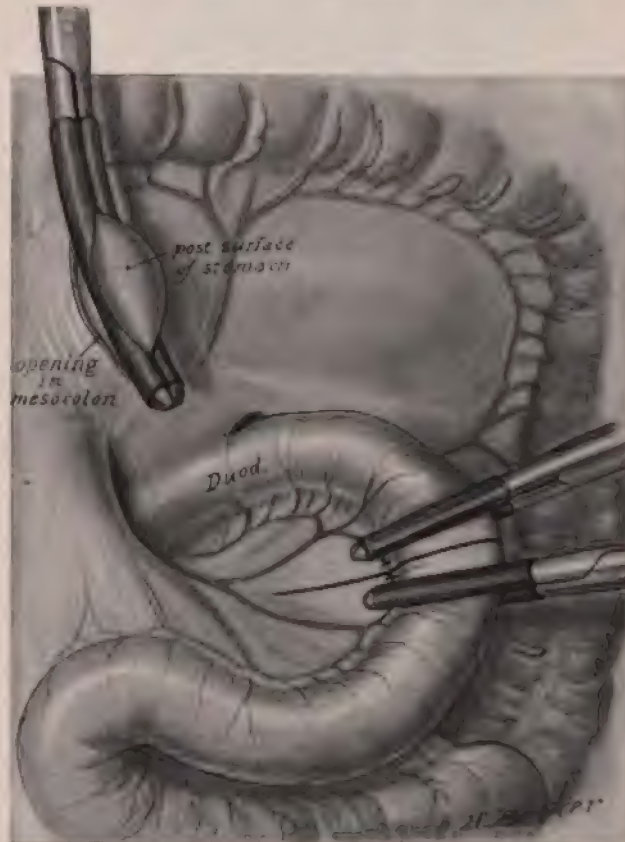


FIG. 575.—ROUX'S METHOD OF GASTRO-ENTEROSTOMY IN Y.

COMPLICATIONS FOLLOWING GASTRO-ENTEROSTOMY.

In the early days of this operation the complications were both numerous and serious, but in recent years the great improvements in technic have made our struggle with these conditions infrequent. It cannot, however, be said, even now, that the operation is free from complications, which may be of very grave import. The following are the most important of these: (1) Hemorrhage. (2) Regurgitant vomiting. (3) Intestinal obstruction. (4) Peptic ulcer. (5) Diarrhea.

Hemorrhage.—Hemorrhage occurring after gastro-enterostomy may be trivial and unimportant, or it may be so copious as to be the cause of death. In the very great majority of cases it is slight in quantity, a few mouthfuls of a black fluid being vomited within one hour of the operation. In other cases it is more abundant, a pint of chocolate-colored fluid being ejected within twenty-four hours; in yet other cases the bleeding may be abundant, and continuous and lethal. The blood may come from an ulcer in the stomach or duodenum, or from the cut edges of the stomach or jejunum engaged in the anastomosis. In a few recorded cases death has

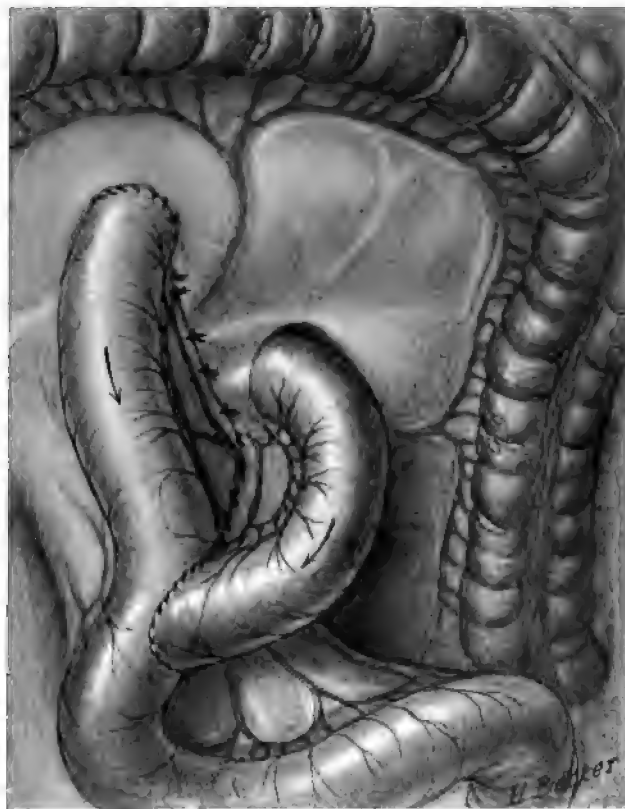


FIG. 576.—ROUX METHOD OF GASTRO-ENTEROSTOMY IN Y.

occurred, and on subsequent examination the blood has been shown to have come from the wound edges; in other cases an open vessel has been found in the base of the ulcer, or there is evidence that in the handling of the stomach during the operation such damage has been done as to set up hemorrhage. Hemorrhage is therefore a preventable complication. It will not occur from the wound edges in the stomach and duodenum if the parts are carefully sutured, and to insure this, certain points must be observed. These are: the use of a continuous suture, not of interrupted sutures; the inclusion of all the coats in the inner (hemostatic)

suture; the firm approximation of the wound edges by this suture; the careful inspection of the suture line after the clamps are removed; the picking-up by a separate stitch of any point from which blood is seen to come. So far as concerns the ulcer itself, bleeding is prevented, first, by the gentle handling of all parts during the manipulations, and especially during the time that the clamps are applied; and, secondly, by the careful infolding of the ulcer in the manner already described.

Regurgitant Vomiting.—Of all the distressing complications after gastro-enterostomy this is the worst. Two varieties should be described: (a) An ob-

struction variety coming on early, and unless relieved causing death. (b) An intermittent form coming on late, and being little more than an occasional distress.

(a) In the former variety vomiting occurs early, is copious and exhausting, and often proves fatal. In the early days of the operation the patients literally vomited themselves to death; an abundant thin, slightly offensive, deeply bile-stained fluid being brought up at brief intervals. In cases of this kind it was found that the cause was an acute intestinal obstruction high in the intestine. This obstruction may be at the afferent opening, the proximal limb of the jejunal loop being waterlogged, and causing a kink at the anastomosis where the jejunum is weakened considerably by the complete division of its circular muscular fibers, or at the efferent opening, where again a sharp kink or a band of adhesions is found. Since the introduction by Petersen and Czerny of the "no-loop" or "short-loop" principle in posterior gastro-enterostomy, regurgitant vomiting of this type has disappeared. I have not seen it in over three hundred consecutive operations.

(b) The intermittent form is observed in cases that have done well after operation and have given no anxiety whatever. At a time which varies from three to four weeks up to six months the patients begin to vomit, and they vomit pure bile painlessly. Even after a meal it is only bile which is vomited, not food. This type of vomiting is more common in the morning; though it may come on at any time during the day, suddenly. It is preceded occasionally by a "swimming" in the head, and faintness. W. J. Mayo¹ has suggested that this bilious vomiting is due to kinking of the jejunum either at the duodenojejunal flexure, or at the anastomosis, when the bowel is applied to the stomach along a line whose direction is from above downward and to the right. He therefore suggested that the anastomosis be made with the bowel passing from above downward and to the left. He further pointed out that this was the natural direction of the jejunum. In deference to so great an authority I followed this method in a series of cases, and in two of these bilious vomiting followed. In all my previous experience I had only seen two such cases, and the proportion occurring after Mayo's line of anastomosis had been followed was therefore unduly great. This led me to make a series of observations upon the jejunal direction. In approximately 60 per cent. of cases the jejunum passes downward and to the left from the flexure. But in the remaining 40 per cent. it may occupy any direction, and my present plan is therefore in performing the anastomosis to discover the normal jejunal direction and to preserve that direction in making the anastomosis. In this way alone can displacements leading to the occurrence of this complication be avoided.

Intestinal Obstruction.—As I have already mentioned, regurgitant vomiting is in reality due to high intestinal obstruction, and may therefore be included under this heading. Other forms of obstruction are met with, such as: (a) Bands or adhesions occurring between the distal limb of the jejunum and the omentum, abdominal wall, transverse mesocolon, etc. (b) Hernia of the small intestine through the opening in the transverse mesocolon into the lesser sac. (c) Strangulation of

¹ Mayo, Wm. J.: "The Technique of Gastro-jejunostomy," *Ann. of Surg.*, 1906, xliii, 537.

the small intestine over the proximal jejunal loop, from right to left or left to right. Cases of this kind are considered by me in detail elsewhere.¹ These complications may be avoided by extreme cleanliness during the operation, so that post-operative local peritonitis (septic?) is not aroused; by closure of the mesocolic opening around the anastomosis; by the avoidance of a jejunal loop between the flexure and the anastomosis.

Peptic Ulcer of the Jejunum.—The occurrence of peptic ulcer in the jejunum after gastro-enterostomy has only attracted general attention since the operation became applied to the treatment of simple ulcers. It does not occur in cases of malignant disease. The ulcer is generally found in the distal limb of the jejunum, almost immediately below the anastomosis; it may be solitary or as many as four may be found. Pathologically and etiologically the ulcer is the counterpart of duodenal ulcer. Tiegel² and Gosset³ have written excellent papers dealing with this subject. Including the cases collected by these two authors, two recorded by Battle, and one case of my own, there are thirty-four cases altogether. The operation performed in these was: In seventeen cases anterior gastro-enterostomy; in four cases anterior gastro-enterostomy with entero-anastomosis; in one case gastro-enterostomy in Y; in six cases posterior gastro-enterostomy with long loop; in one case posterior gastro-enterostomy with entero-anastomosis; in one case posterior gastro-enterostomy with short loop. In the remainder the nature of the operation is not mentioned.

The time which elapsed between the performance of the gastro-enterostomy and the discovery of the peptic ulcer has varied from ten days to nine years.

The clinical forms in which the symptoms may appear are three:

1. The symptoms are the same as those of duodenal ulcer; pain some time after food, burning flatulent distention, hyperacidity.
2. Acute perforation occurs without inaugural symptoms.
3. The symptoms recur, and a "subacute" perforation occurs; there is an abundant localized plastic peritonitis, and a lump may be felt in the epigastrium.

The latter forms are described by Tiegel, but I have seen one case, as yet unrecorded, of the first type. It is not improbable that in some of the cases where operation is supposed not to have relieved the original condition of duodenal or pyloric ulcer, the symptoms may in reality be due to secondary peptic ulceration in the jejunum.

So far as the cause is concerned, hyperacidity would seem to be the most frequent. It was noticed in eighteen of the thirty-three cases; in the majority of the fifteen remaining cases no observations upon this point were made. Gosset asserts that three factors are at work—hyperacidity, tight stenosis of the pylorus, and great dilatation of the stomach. These, I think, are only the conditions usually present

¹ Moynihan, B. G. A.: "Abdominal Operations," 1906, pp. 205-211, second edition, W. B. Saunders Co., Phila. and London.

² Tiegel, Max: "Ueber peptische Geschwüre des Jejunums nach Gastro-enterostomie," Mitth. a. d. Grenzgebiet, 1904, xiii, No. 31, p. 897.

³ Gosset, A.: "L'ulcère peptique du jéjunum," Rev. de Chir., 1906, xxxiii, 54.

when gastro-enterostomy is performed. They are factors necessitating operations in the first instance, but can hardly be supposed to have any causative influence in producing a peptic ulcer. A fourth cause, which was mentioned by Garre at the discussion at the first meeting of the International Surgical Society, was the want of accurate apposition of the mucous edges at the time of operation. A raw surface is left which allows of easy digestion by the hyperacid gastric juice. This probably accounts for some cases, but in the majority of cases the ulcer is not exactly at the opening, but an inch or more away.

In the series there were three cases in which a fistula had formed between the jejunum and the colon.

In several of the cases it was noticed that a local swelling (generally to the left side of the epigastrium) was present. In some of these active peristalsis of a much distended coil of bowel was seen. This occurred when an anterior gastro-enterostomy had been performed; it was due to the distention of the coil of jejunum between the flexure and the anastomosis. Owing to the plastic peritonitis around the perforation, an acute intestinal obstruction had been caused at this high point in the bowel.

The occurrence of peptic ulcer is certainly the most serious of all disasters after gastro-enterostomy. It is therefore necessary in all cases of duodenal ulcer to insure that adequate care in the after-treatment is observed. If hyperchlorhydria has been marked or persistent, there should be a continued administration of alkalis, and great care in diet for weeks, or, if need be, months. If operation is called for, a jejunal resection is probably the best treatment and the subsequent making of a new anastomosis.

Diarrhea.—This is an occasional sequel to the operation deserving of mention because of the fact that it has in rare cases proved fatal. Our knowledge of the subject has been advanced by Anschütz¹ and Kelling.²

Kelling remarks that in the cases which prove fatal no obvious explanation of the diarrhea is discoverable. He suggests that there are two forms: First, that in which the diarrhea is due to the escape into the intestine of acid contents not neutralized by the bile and the pancreatic juice; second, that in which it is due to "fermentation." The latter is not serious, and is seen only or chiefly in patients suffering from carcinoma, or in those cases where there is an absence of free HCl.

The explanation of the first form lacks adequate confirmation. In spite of the fact that both bile and pancreatic juice may almost constantly be found in the stomach after gastro-enterostomy, acid contents may still escape into the intestine, and may, indeed, cause peptic ulcer. But it has not yet been suggested or recognized that diarrhea occurs especially in those suffering from hyperchlorhydria, as one would expect if this hypothesis were accurate.

With regard to the explanation of the second form, this may be true in certain

¹ Anschütz, Willy: "Ueber die Darmstörungen nach Tragenoperationen," *Mitth. a. d. Grenzgebiet*, 1905, xv, 305.

² Kelling, George: "Studien zur Chirurgie des Magens," *Archiv. f. klin. Chir.*, 1900, lxii, 32.

cases. Fermentation may go on to such a degree in the stomach that no amount of careful lavage will insure the cleanliness of the mucosa. This may be proved by examining a pyloric growth after pylorotomy has been performed; the recesses of the regular mass are sometimes extremely foul. The delivery of putrid, fermenting food into the jejunum would, of course, instantly set up diarrhea. It is always remarked that the stools in such a case are "very offensive." But in not a few cases the diarrhea does not appear at once, but only after several days, when the patient has perhaps been doing well. It should be remarked that cases have occurred after partial gastrectomy, when the infective area has been removed.

Anschütz believes the chief cause to be the excessive weakness of the patient, and remarks that the same type of diarrhea is seen in those who suffer from advanced carcinoma elsewhere, or from extensive tuberculous disease apart from intestinal lesions. Carle and Fantino remark that the food runs through the intestine like water through a rubber tube, which is powerless to hasten or impede its progress.

It is apparent that no adequate explanation of this complication can be given, but it is probable that a strict attention to the diet, the administration of only sterile foods for some time after the operation, the giving of opium early, and the exhibition of drugs, such as isoform, naphthol, salol, etc., whose purpose is to act as disinfectants, will comprise the most effective means at our disposal for preventing and for checking the onset of this symptom.

EXCISION OF ULCERS.

There are certain cases of chronic ulcer of the stomach which are not suitable for gastro-enterostomy. When the ulcer is situated on the lesser curvature in its cardiac half, the performance of a short-circuiting operation will not afford relief, or will relieve only for a time, the symptoms recurring with as great severity as ever within a few months of the operation. In two such cases I performed gastro-enterostomy, three, and three and a half years ago; in both cases there was great improvement for a time, but in both a relapse has occurred. If an ulcer on the lesser curvature is solitary, it should be excised; if there are more ulcers than one, an ulcer near the cardia and an ulcer at the pylorus causing stenosis, the former should be excised and gastro-enterostomy then performed; or if the patient's condition be very serious, gastro-enterostomy alone may be done at the first, and the excision of the ulcer deferred till a more suitable occasion.

The excision of the ulcer is carried out in the following manner: The abdomen is opened and the stomach inspected, and surrounded at the sides and below with swabs. The gastrohepatic omentum is then cut through about one inch away from the stomach, above the ulcer, and the incision carried down to the lesser curvature. On the curvature the coronary artery is divided at each side of the ulcer; two ligatures are tied at each point and the artery is severed between them. The finger is then passed into the lesser sac to discover the presence of adhesions between the ulcer and the pancreas. These, if found, are separated, and, the stomach

being free, the clamps are applied. The area of the stomach embraced by them should be triangular, the base being at the lesser curvature, the apex pointing toward the greater curvature. The wedge-shaped portion of the stomach between them is to be removed, but it is important that the depth of the wedge should be no greater than is absolutely necessary; for if much of the stomach, in depth, is removed, an unsightly and possibly troublesome kink may result. The clamps being applied, the stomach area between them is removed. The closure of the wound left is begun by suturing the posterior margins at the point nearest the greater curvature. The needle is passed from the mucosa of one side to the mucosa of the other, and then returns from mucosa to mucosa, where a knot is tied. The suture begun in this way is continued with the "loop on the mucosa" stitch already described; it is continued upward along the posterior surface to the lesser curvature, then down on the anterior surface. This stitch is then tied and cut short. The whole suture line should be secure, and when the clamps are removed should be water-tight. A second outer suture is now introduced, which picks up the serosa and muscularis, and infolds and reinforces the first line. The inner suture may be of catgut; the outer should be of celluloid thread or silk.

It is important in this operation to have as much as possible of the healthy stomach wall between the ulcer which is to be removed and the greater curvature, so that there shall be no present kinking, and no risk of subsequent contraction resulting in stenosis.

THE OPERATIVE TREATMENT OF HOUR-GLASS STOMACH.

Definition.—By the term hour-glass stomach is understood that condition in which, as the result of a narrowing in the body of the stomach at any point between the cardiac and pyloric orifices, the organ is divided into two cavities.

Hour-glass stomach (*Sanduhrmagen, l'estomac biloculaire*) is always the result of a pathologic change occurring in the body of the stomach; it is never congenital in origin. The constriction which divides the stomach into two pouches may be due to chronic ulceration, to cancer, or to adhesions pressing upon the stomach (rarely). A chronic ulcer, more especially the saddle-shaped ulcer which extends along the lesser curvature and down both surfaces, in healing puckers the stomach in or near its center; as a rule, the greater curvature is drawn up to the lesser, but I have twice seen the lesser pulled down to the greater curvature. In the majority of cases of hour-glass stomach the scar of other ulcers is seen at or near the pylorus, or in the duodenum—testimony of some value in support of the fact that ulcer of the stomach is not usually solitary. The result of this double constriction is that the food has difficulty in escaping from the cardiac pouch to the pyloric pouch, and from the latter into the duodenum; both pouches then undergo dilatation and perhaps hypertrophy. The pyloric pouch in such circumstances has been mistaken for the whole stomach and a futile operation of anastomosis performed between it and the intestine.

Symptoms.—An hour-glass stomach can usually be recognized by attention to the following symptoms and signs:

1. If the stomach-tube be passed, and the stomach washed out with a known quantity of fluid, the loss of a certain quantity will be observed when the return fluid is measured. Thus, if 30 ounces be used, only 24 can be made to return. Wölfler, who called attention to this sign, said that some of the fluid seemed to disappear “as though it had flowed through a large hole”—as indeed it has, in passing from the cardiac to the pyloric pouch (Wölfler’s “first sign”).

2. If the stomach be washed out until the fluid returns clear, a sudden rush of foul, evil-smelling fluid may occur; or, if the stomach be washed clean, the tube withdrawn and passed again, in a few minutes several ounces of dirty offensive fluid may escape. The fluid has regurgitated through the connecting channel between the pyloric and cardiac pouches (Wölfler’s “second sign”).

3. “Paradoxical dilatation.” If the stomach be palpated and a succussion splash obtained, the stomach-tube passed, and the stomach apparently emptied, palpation will still elicit a distinct splashing sound. This is due to the fact that only the cardiac pouch is drained; the contents of the pyloric remain undisturbed and cause the splashing sound on palpation. For this phenomenon Jaworski has suggested the appropriate name “paradoxical dilatation.” Jaboulay has pointed out that if the cardiac locus be filled with water, a splashing sound can still be obtained by palpation over the pyloric pouch. The sign of paradoxical dilatation is best elicited after washing out the stomach in the ordinary manner. When the abdomen is examined at the completion of the washing, and when the stomach has been apparently drained quite dry, a splashing sound is readily obtained, for some of the fluid used has escaped into the pyloric pouch through the connecting channel.

4. Von Eiselsberg observed in one of his cases that on distending the stomach a bulging of the left side of the epigastrium was produced; after a few moments this gradually subsided, and concomitantly there was a gradual filling up and bulging of the right side.

5. Von Eiselsberg also called attention to the bubbling, forcing, “sizzling” sound which can be heard when the stethoscope is applied over the stomach after distension with CO_2 . If the two halves of a Seidlitz powder are separately given and the stomach be normal or dilated, no loud sound is heard anywhere except at the pylorus; if a constriction is present in the stomach, a loud, forcible, gushing sound can be easily distinguished at a point two or three inches to the left of the middle line.

6. I first called attention six years ago to a sign which I have since found of great service in establishing a diagnosis of hour-glass stomach. The abdomen is carefully examined and the stomach resonance percussed. A Seidlitz powder in two halves is then administered. On percussing, after about twenty or thirty seconds an enormous increase in the resonance of the upper part of the stomach can be found, while the lower part remains unaltered. If the pyloric pouch can be felt, or seen to be clearly demarcated, the diagnosis is inevitable, for the increase in resonance must

be in a distended cardiac segment. If the abdomen be watched for a few minutes, the pyloric pouch may sometimes be seen gradually to fill and become prominent.

7. Schmidt-Monard and Eichhorst have seen a distinct sulcus between the two pouches inflated with CO_2 . In one of my cases the pouches could be emptied, one into the other, through the constriction.

Operative Treatment.—The operative treatment of hour-glass stomach at times offers very serious difficulties. In the first place, there may be two constrictions—one in the body of the stomach and one at the pylorus. If so, a double operation may be necessary, for gastro-enterostomy from the cardiac pouch leaves the pyloric pouch undrained, and an anastomosis from the pyloric pouch, being beyond the first and most important obstruction, can give no relief. Again, the cardiac pouch in some cases is small; in one instance I have seen it no larger than an orange. In such circumstances it is inaccessible, or almost so; and if adhesions conceal it, the mechanical difficulties of any operation are excessive. The supreme fact to be borne in mind is that before any operation is undertaken the whole stomach, from cardia to pylorus, must be examined. In one of my own cases a trifid stomach was discovered; but for this rule it would certainly have been overlooked.

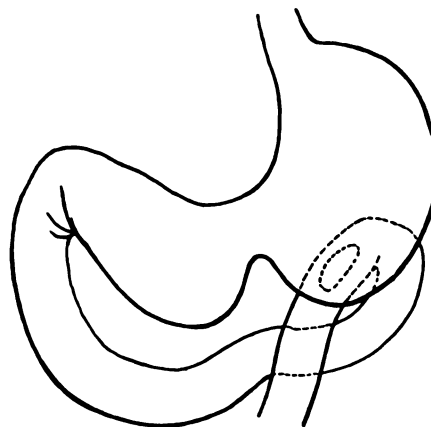


FIG. 577.—OPERATION FOR HOUR-GLASS STOMACH.

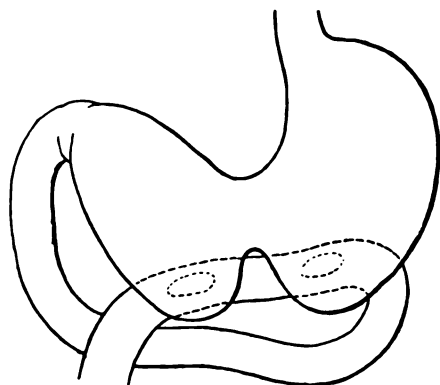


FIG. 578 —OPERATION FOR HOUR-GLASS STOMACH
(Weir and Foote).

The various operations that may be practised are: (1) Gastro-enterostomy from the cardiac pouch. (2) Gastro-enterostomy from both pouches, Weir and Foote's operation. (3) Gastro-enterostomy in Y into both pouches, Monprofit's operation. (4) Gastroplasty. (5) Gastro-gastrostomy. (6) Partial gastrectomy. (7) Digital divulsion of the constriction.

1. Gastro-enterostomy from the cardiac pouch is the operation often most practicable; for the cardiac pouch is almost always the larger and the pyloric pouch may be small and negligible. The operation is performed between the cardiac

pouch and the jejunum, exactly as if the pouch were the whole stomach (Fig. 577).

2. Weir and Foote suggested that the loop of jejunum selected for the anastomosis with the stomach should be united to both pouches, first to the cardiac, then the pyloric, both of which would, therefore, be drained (Fig. 578).

3. Monprofit performed an anastomosis between the two pouches and the jejunum after the method of Roux, the gastro-enterostomy in Y. The necessity for a double division of the jejunum and of four anastomoses is an insuperable objection to this operation.

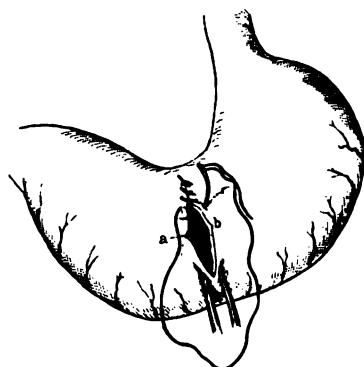
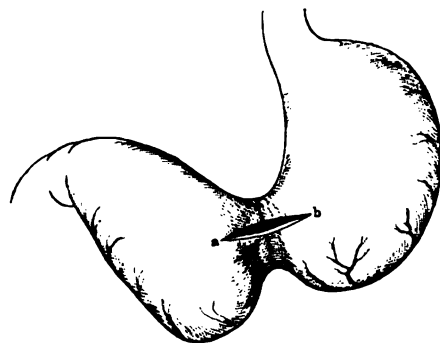


FIG. 579.—GASTROPLASTY FOR HOUR-GLASS STOMACH.

4. Gastroplasty. In my early cases I performed gastroplasty with the same hopefulness as pyloroplasty; but in both operations I have been disappointed. Gastroplasty is the operation of pyloroplasty applied to the body of the stomach (Fig. 579). It is only applicable, therefore, in those cases in which there is no active ulceration, when the scar tissue is of limited extent, and where the induration is not extensive. If it is ever to meet with success it must be performed in the manner suggested by Kammerer,¹ of New York, which is an application to gastroplasty of a method which bears to it the same relationship as does Finney's operation to pyloroplasty. The following is Kammerer's description:

"Beginning at the lowest point of the constriction, a running suture was applied

through the serous and muscular coats, bringing the vertical edges of both compartments of the stomach into close approximation along their posterior margins. An inverted V-shaped incision was now made through the entire thickness of the stomach-wall, about $\frac{1}{4}$ inch to either side of the Lembert suture (Fig. 580). The posterior wound edges were now brought together with another running suture from within, the same procedure being then applied to the anterior edges from without. The final act of the operation consisted in reinforcing the anterior suture with a running Lembert stitch, and placing a few extra sutures at the lowest point of the stomach through the serous and muscular coats, where tension would naturally be greatest."

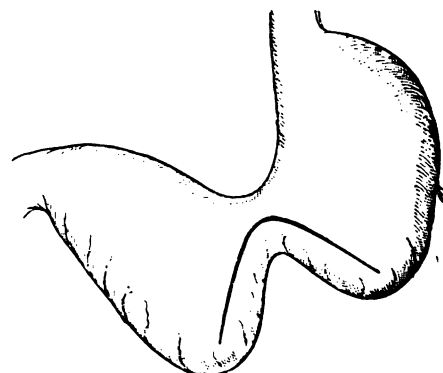


FIG. 580.—KAMMERER'S GASTROPLASTY FOR HOUR-GLASS STOMACH.

¹ Kammerer, F.: "Hour-glass Contraction of the Stomach," *Ann. of Surg.*, 1903, i, 281.

5. Gastro-gastrostomy or gastro-anastomosis is suited to those cases only in which there is no obstruction at the pylorus. The two pouches are united to one another by an anastomotic opening which reaches from the lesser curvature to the greater (Fig. 581). When the stomach is well drawn into the wound, a clamp is placed on each pouch close to the isthmus, and is made to embrace the whole depth of the stomach, from one curvature to the other. The clamps are then isolated by gauze, and the parts embraced by them united by suture, in exactly the same manner as in gastro-enterostomy.

6. Partial gastrectomy is applicable to the cases in which the stenosis in the stomach is due to carcinoma, the whole of the isthmus, the gastro-hepatic omentum, and the adjacent glands on both curvatures are removed, and an end-to-end anastomosis made between the two cut surfaces.

7. Digital divulsion may be described as the application of Loreta's operation to the constriction in the stomach. It is never likely to have any but the most restricted rôle. In one case, however, it yielded me, when all other measures were impossible, a most remarkable result.

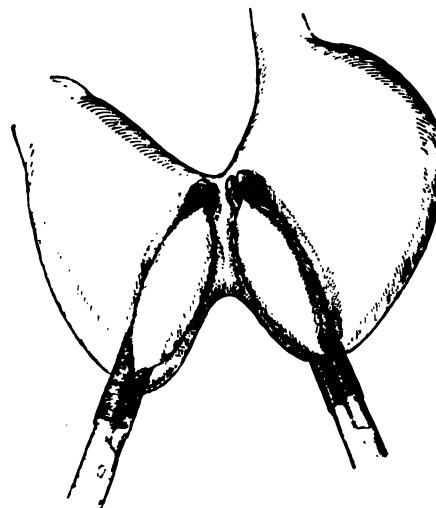


FIG. 581.—GASTROGASTROSTOMY FOR HOUR-GLASS STOMACH.

GASTRECTOMY.

Definition.—Gastrectomy is the operation in which a removal of the whole or a part of the stomach is undertaken. It is described as “complete gastrectomy” in the former case, as “partial gastrectomy” in the latter. The term “pylorectomy” was formerly used to indicate the removal of a growth having its origin in the pylorus, but the term has now, very properly, fallen into disuse.

History.¹—The first experimental work dealing with the question of resection of the stomach was undertaken in 1810 by Merrem, who removed the pylorus with success in one case. In 1876 Gussenbauer and Winiwarer, and later Czerny of Heidelberg, performed a series of successful operations upon dogs, and suggested the possibility of similar operations in the human subject. On April 9, 1879, Péan performed the first “pylorectomy” in man, and in 1880 Rydygier the second; both operations were unsuccessful. On February 28, 1881, Billroth performed the first operation which was followed by recovery; a malignant tumor of the pylorus was removed. Since this time a large amount of work, pathologic, anatomic, and oper-

¹ For a history of this operation with references see Rydygier, Ludwig: “Meine Erfahrungen über die von mir seit 1880 bis jetzt ausgeführter Magenoperationen.” Deut. Zeit. f. Chir., 1901, lviii, 197.

ative, has been undertaken, with the gratifying result that the removal of carcinoma of the stomach can now be undertaken with a success that only ten years ago seemed unattainable. The work upon the lymphatics of the stomach by Cunéo, upon the pathologic anatomy of carcinoma of the stomach by Mikulicz, Borrmann, and Cunéo, and upon the operative technic by Mikulicz, Hartmann, Rutherford Morison, Moynihan, and W. J. Mayo, is all noteworthy.

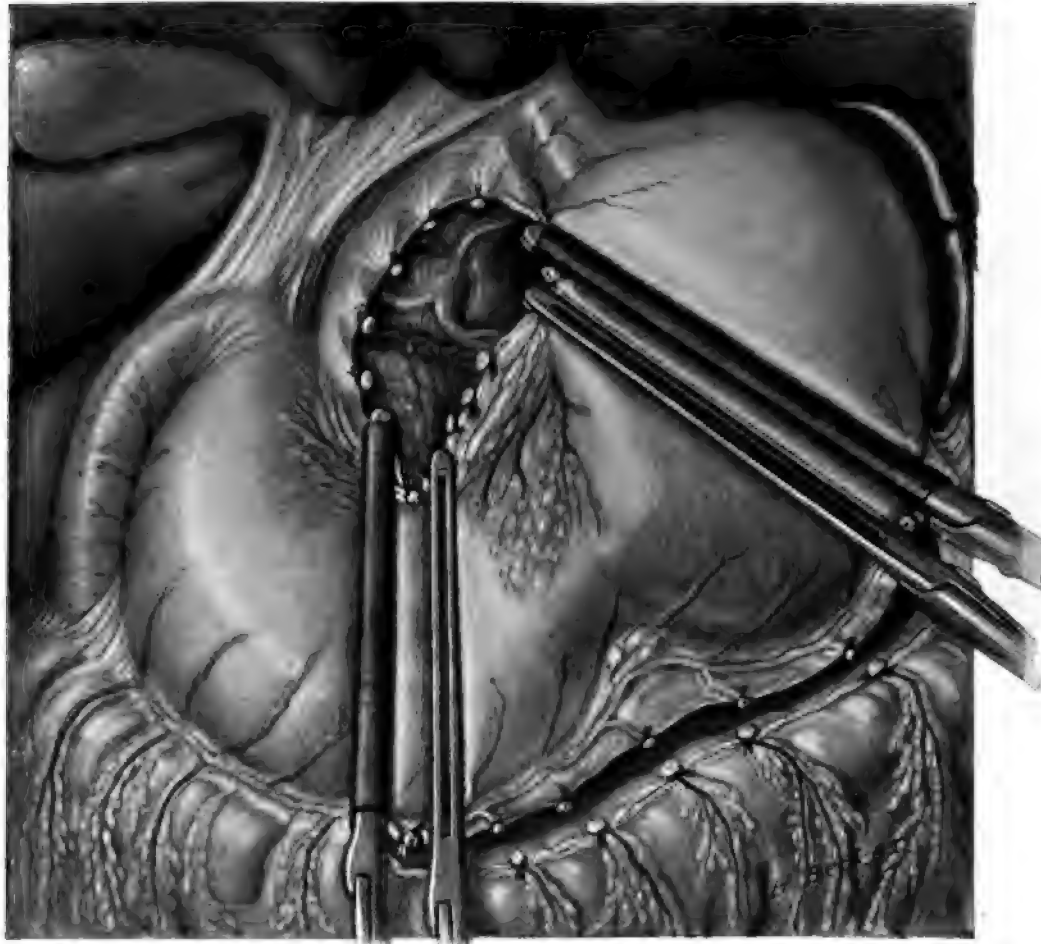


FIG. 582.—PARTIAL GASTRECTOMY FOR HOUR-GLASS STOMACH.

Complete gastrectomy was first performed in 1883 by Connor, of Cincinnati, in 1884, by Schuchardt, and in 1892 by Maydl; all the patients died. The first successful complete gastrectomy was performed by Schlatter, of Zurich, on September 6, 1897; the second case by C. B. Bringham, of Boston, on February 24, 1898. In the former of these the cut end of the esophagus was united to a loop of the jejunum by suture, the duodenal end being closed; in the latter the cut ends of the esophagus and duodenum were united over a Murphy button.

Conditions for Which the Operation is Performed.—Complete gastrectomy has only been undertaken in cases of carcinoma of a large part of the stomach. Its rôle will always be very limited, and no cases but those of malignant disease are ever likely to be submitted to so serious an operation.

Partial gastrectomy in the great majority of cases is performed for carcinoma of the stomach, beginning in or near the pylorus, or more rarely in the body of the stomach. In certain cases the removal of a large part of the organ may be thought necessary in cases of simple ulcer, and W. L. Rodman has suggested as the ideal operation for ulcer occupying the pylorus or pyloric antrum, in which ulcers are not seldom multiple, the "excision of the ulcer-bearing area" (Rodman's operation). In cases of ulcer with excessive induration a large tumor may be formed, and the mimicry of malignant disease by such a mass is complete; Czerny, Kocher, and others have removed such tumors in the belief that they were dealing with carcinoma. In cases of chronic ulcer of the stomach the removal of the ulcer may, at times, be necessary; for example, when the ulcer occupies the lesser curvature and is adherent to the under surface of the liver or the diaphragm. In such cases gastro-enterostomy alone does not afford complete relief, and a "partial gastrectomy" is therefore desirable. In some cases of hour-glass stomach an indurated ulcer at the isthmus may be removed, and the two pouches anastomosed.

Carcinoma of the Stomach.—

Cancer of the stomach may affect the orifices or any part of the body of the organ. In the great majority of cases it commences within 3 inches of the pylorus. An investigation of cases under my own care¹ showed that two forms of diseases may be present—"pyloric" and "pre-pyloric." In the pyloric growths the dis-

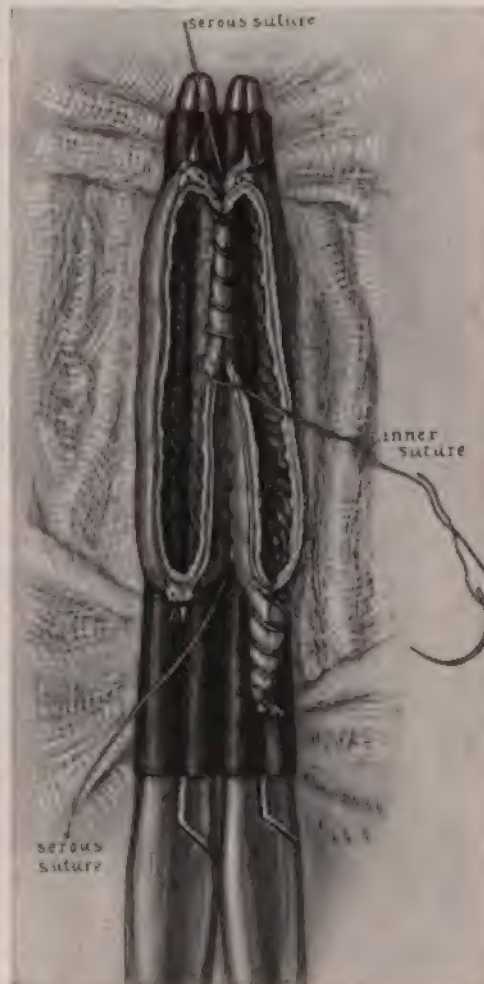


FIG. 583.—PARTIAL GASTRECTOMY FOR HOUR-GLASS STOMACH.

¹ Moynihan, B. G. A.: "A Review of a Series of Operations for Cancer of the Stomach," Brit. Med. Jour., 1906, i, 370.

ease begins in the pylorus or within a very short distance of it, and at the earliest stage begins to cause constriction there. The tumor, as a rule, is comparatively small, is largest at the pylorus, and gradually tails off along the curvatures, chiefly the lesser curvature. At an early stage there is enlargement of the coronary glands. The "pre-pyloric" growth begins almost always at the same point, on the lesser curvature, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches from the pylorus. The growth spreads along the curvature in both directions, but chiefly away from the pylorus, drifting along with the lymphatic stream. It is, therefore, some little time before the pylorus itself is involved, or before there is such an increase in the size of the growth as to



FIG. 584.—PARTIAL GASTRECTOMY FOR HOUR-GLASS STOMACH.

determine obstruction. The origin of the growth, as indicated by the thickest part of it, is on the lesser curvature; from here the growth extends along the curvature in both directions, and down both anterior and posterior walls. Two wings of growth are, as it were, hinged on to a body which is longer than either, thicker in the middle, and tapering toward each end.

The *symptoms* in the two forms of growth—"pyloric" and "pre-pyloric"—differ to a degree which should make their recognition before operation a matter of little or no difficulty. In the pyloric form the symptoms from the outset are of an obstructive character; there are stasis of food, inability to take solids, and vomiting

in quantities which increase with the increasing capacity of the stomach. In these cases the stomach is obviously dilated, and waves of peristalsis are easily seen or easily elicited by slight inflation of the stomach. A growth placed as these are need not be of large size to cause the most marked symptoms. It does not require a large mass to block the pylorus effectively.

In the "pre-pyloric" form the symptoms are not obstructive in the earliest stage; it is only when the pylorus is invaded, or the large size of the growth blocks the narrow pyloric antrum, that there is any impediment to the onward passage of food. Before this time the symptoms are loss of appetite, intolerance of solid food, uneasiness after meals, occasional vomiting of a turbid watery fluid in small quantities, and loss of weight. These symptoms are all mentioned in the history of my cases, though any one or more, or even all, of them may be absent in any individual patient.

The connection between ulcer of the stomach and carcinoma is becoming clearer. The pathologic evidences of any connection are at present slight. It is comparatively rare to see a specimen in a museum or on the post-mortem table in which the evidence is clear that an ulcer has preceded the development of cancer; but this is hardly surprising, for the final ruin of the disease, which is then open to inspection, has no trace remaining of the early stage of its history. It is probably by the examination of specimens removed by operation that the connection between ulcer and cancer will be demonstrated. What is quite certain is that the majority of the cases of carcinoma which now come to the surgeon for treatment give a clear history of chronic gastric ulcer, such a history as, with our present experience would have compelled the surgeon to have advised operation years before, had his opinion then been asked. It is curious to find that the statistics of W. J. Mayo, Mayo Robson, and myself all show that in almost exactly 60 per cent. of cases of cancer it is as certain as a reliable clinical history can make it that the disease has sprung up in a stomach which has previously been the seat of a chronic ulcer. The diagnosis of carcinoma of the stomach in an earlier stage than is now customary will be possible if the following type-history be borne in mind.

The type-history of a case of carcinoma is as follows: A man or woman of middle age has suffered for a few or for many years from indigestion, pain after food, vomiting, and inability to take the ordinary food in ordinary quantity; these symptoms have, it may be, come on in "attacks," in the intervals of which there has been comparative or complete freedom from suffering. At last an "attack" comes that is more rebellious than the others, vomiting is more persistent, and the loss of weight is unusual. The remedies which before gave relief are now without effect. If in such a patient there be gastric stasis, food being retained for ten or twelve hours, if there be persistent absence of free HCl after a test meal, if lactic acid be present, and if in the test meal when removed blood is found on microscopic examination, then there is a very strong warrant for a diagnosis of carcinoma, and an exploratory operation is not only justified—it is demanded. In discussing this question of exploration, it is well to be clear. There can be no question that an exploratory operation is a confession of diagnostic failure; we do not explore the abdomen for condi-

tions which we can now diagnose with certainty, conditions, it may be, which twenty years ago we were not capable of recognizing with precision, conditions such as duodenal ulcer or stone in the common duct. But no one would hesitate to say that positive recognition of cancer of the stomach in its early stage—in the stage, that is, when it could be completely eradicated—is, with present clinical methods, almost impossible. If so, it should be frankly admitted, and the only certain method—exploratory operation—be vindicated. If the clinical history of a case is such that suspicions created at the first are not quickly allayed, then the abdomen should be opened to enable a diagnosis to be made. Exploration should be used for the purpose of *making*, not with the object of *confirming*, a diagnosis. It is probable that, as in other matters, the comparison of the history and of the conditions revealed at operation will lead by degrees to greater assurance in our diagnosis. Before an exploratory operation is sanctioned, however, the clinical investigation should be as complete as it is possible to make it.

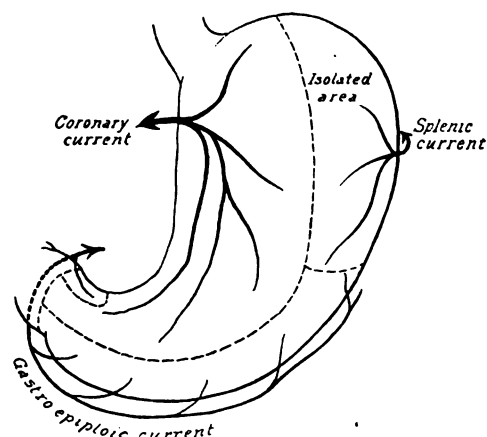


FIG. 585.—THE LYMPHATIC AREAS OF THE STOMACH (after Cunéo).

Pathologic Anatomy.—The growth having once begun in the stomach, it is necessary, before purposeful operative measures can be adopted for its relief, that we should possess accurate knowledge of the lymphatic distribution of the organ; for the successful operative treatment of malignant disease in any organ implies a full and accurate knowledge of its lymphatic supply.

There are in the stomach three lymphatic areas:

1. An area along the lesser curvature, occupying two-thirds of the depth of the stomach; its lymph-vessels run obliquely upward and to the left to the coronary glands which lie along the lesser curvature as far up as the esophagus.
2. An area along the greater curvature, occupying one-third of the breadth of the organ; its lymph-vessels run obliquely to the right, and end in the glands of the greater curvature which lie along the right gastro-epiploic artery.
3. An area occupying the greater tuberosity of the stomach, which is disconnected, so far as its lymphatic supply is concerned, from the rest of the organ—this is the “isolated area.” Its vessels run to the left and terminate in glands in the hilum of the spleen.

The removal of the growth which begins as a “pyloric” or “pre-pyloric” cancer must, therefore, involve the removal of the growth itself, of all the lymphatic vessels draining the area of the growth, of the glands into which those vessels empty.

To effect this, it is clear that the whole of the lesser curvature up to the esophagus must be taken away. The point on the greater curvature at which the point of sec-

tion is to be made should in theory be at the margin of the "isolated area," as I described it in my first paper,¹ but in practice such an operation is technically very difficult. It is to Cunéo and Hartmann that we are indebted for a very helpful suggestion. These surgeons point out that as the lymphatic current along the greater curvature was *toward* the pylorus and the growth, the involvement of these vessels by the spread of the carcinoma was unlikely, and they accordingly suggested that a much larger part of the greater curvature might safely be left than on purely theoretic grounds was desirable. The point usually chosen for the division of the stomach is vertically below the right margin of the esophagus (approximately).

The only remaining point is concerned with the section of the duodenum. It has long been well recognized by pathologists that the duodenum is very seldom invaded, and never invaded extensively by a pyloric cancer. The removal of the first part of the duodenum is ample to insure that all growth on that side is removed. The lymphatic glands which must be removed include those along the lesser curvature in the gastrohepatic omentum, and those along the greater curvature, especially in the pyloric region, where they are numerous. After the stomach has been removed, glands can also be removed from the upper border of the pancreas without difficulty. In one of my own cases the glands, which were not laid bare until the visceral removal was complete, were unusually large, but were taken away from the front of the aorta and vena cava above the pancreas, without difficulty. After the removal of the diseased mass is complete a careful search is made in all the parts where glandular infection is likely to have occurred, and glands, if enlarged, are removed. It must always be remembered that in malignant disease the glandular implication does not always follow anatomic lines strictly, for when the lymphatic current is checked in one direction a retrograde current occurs. In the case of my own, already referred to, where many glands along the pancreas, especially at its duodenal end, were removed, the patient is well and free from recurrence four years and nine months after the operation.

PARTIAL GASTRECTOMY.

Such, then, are the principles of the operation of partial gastrectomy for carcinoma pylori: the following are the details of its performance:

The abdomen is opened through a small central or slightly lateral incision and the extent and connections of the growth explored. If a removal of the carcinoma is possible, the incision is rapidly enlarged to the fullest extent—about 8 inches—and the stomach and duodenum fully exposed. The general peritoneal cavity is packed off as usual with two layers of moist hot swabs, an outer very large and an inner smaller, which is changed from time to time as is found necessary. The operation will be rendered easier and some loss of blood will be prevented by a preliminary ligature of the vessels before any of their branches are cut. The first

¹ Moynihan, B. G. A.: "The Operative Treatment of Cancer of the Pyloric Portion of the Stomach," Clin. Soc. Trans., 1901, xxxv, 84.

step in the operation is the ligation of the coronary artery. The vessel is secured as it approaches the lesser curvature of the stomach at its highest accessible point. In order so to ligature it, the stomach is pulled well downward until the upper part of the gastrohepatic omentum is made taut, and the liver is forcibly elevated by the hand of an assistant. The vessel can be seen or felt. It is surrounded by a catgut ligature (No. 4) passed in a large curved intestinal needle. The ligature embraces not only the artery, but also a small piece of the gastrohepatic omentum—the *falx coronaria*—which enfolds it. The needle is passed with a double thread, the two portions of which are pulled apart and ligatured at least one-half inch from each other; the vessel is cut between them. The incision thus made in the gastrohepatic omentum is continued just on to the lesser curvature of the stomach at the point where the section of the viscus is afterward to be made. The upper cut end of the vessel retracts a little toward the esophagus. In placing the ligature on the artery it is desirable to make sure that it lies below the point of origin of those branches of the main trunk which are given off to the lower subdiaphragmatic portion of the esophagus.

The gastric artery being safely ligatured, the gastrohepatic omentum is divided as close to the liver as possible, along a line which extends from the small incision already made by the division of the artery to the duodenum. In many cases the gastrohepatic omentum is extremely thin and it tears through readily, even unexpectedly. If it is thicker, it is ligatured off in two or three bundles; a large curved intestinal needle armed with catgut being passed to secure a portion, which is at once ligatured and divided. When these bundles have been secured, the upper end of the pylorus will be reached, and it is here that the superior pyloric artery is ligatured. This vessel may be taken alone, or the occasional common trunk for it and for the gastroduodenal artery may be secured. If the vessels come separately from the hepatic trunk, as is the rule, the superior pyloric artery alone is taken, the ligature of the gastroduodenal being left till the duodenum is divided.

When the vessel is secured by a catgut ligature, a couple of fingers of the left hand are passed behind the stomach in order to free any adhesions which may perhaps exist between it and the pancreas.

When the lesser curvature and posterior surface of the stomach are free, two or three hot moist swabs are packed above the lesser curvature into the lesser sac, so that the posterior wall of this sac is completely protected.

The left index-finger is now passed from above the pylorus behind the first part of the duodenum and is made to project at its lower border. The finger is then pushed through the great omentum here, at a point about one inch beyond the pylorus. Along the track occupied by the left index-finger two pairs of clamps are now passed upward side by side. The distal clamp is rubber-covered; the proximal, about one-half inch away from it, has naked blades. When both are securely placed, the duodenum is divided between them (Fig. 586). The proximal clamp is pressed home as tightly as possible, but in the subsequent manipulations it may possibly be loosened. To prevent this, a couple of stitches are passed above and below, through all the coats of the duodenum, and are tied over the clamp. This

clamp is now wrapped round with hot moist gauze, so that contact with the cut mucous surface is impossible.

The distal cut end of the duodenum may now be closed, or if it is thought that subsequent union of it to the posterior surface of the stomach will be possible, it may be left for the present securely wrapped in a hot moist gauze swab. The closure of the duodenum may be effected by a double layer of sutures, one through-



FIG. 586.—PARTIAL GASTRECTOMY FOR CARCINOMA OF THE PYLORUS.

The figure shows application of the clamps to the duodenum with line between them where division is made; the gastroduodenal artery is ligated and the gastrohepatic omentum tied off. The figure also shows the line of division of the gastrocolic omentum, the points for ligating the vessels, and the line for division of the stomach.

and-through, taking all the coats, the other a seromuscular suture; or the cut end may be surrounded by a purse-string suture and infolded, a supporting serous suture being then applied.

The stomach, which has been freed along the lesser curvature and at the duodenum, can now be lifted well out of the abdomen, and the subsequent manipula-

tions easily performed. The next step is to secure, if this has not been already done, the gastroduodenal artery. To do this, the clamp on the duodenum is pulled forward and to the left to raise the pylorus from the pancreas behind. The vessel is then found in the pancreatico-duodenal recess. It is ligatured in two places and divided between.

The division of the great omentum is then performed; and of all the steps in the operation this is perhaps the one which calls for the greatest care, for it is at times



FIG. 587.—PARTIAL GASTRECTOMY FOR CARCINOMA OF THE PYLORUS.

The duodenal and the stomach openings are shown sutured with continuous through-and-through sutures.

difficult to avoid wounding the middle colic artery, and damage to this vessel involves the risk of gangrene of the transverse colon. The omentum must be cut through below the gastro-epiploic vessels, for it is along these that the glands lie, and the glands must be removed with the stomach. The omentum is secured in sections, either at once by ligature with catgut, or by a series of forceps, one placed beyond the other. The parts gripped in each forceps are then separately ligatured. It is quicker to display each portion to be ligatured upon the left index-finger which

lies behind the omentum in the lesser sac, to pass a curved needle around the part so made plain, and at once to tie and cut through the section. The next inch or so of the omentum is then displayed and similarly ligatured, and so on until that point on the greater curvature is reached which has previously been determined upon as the limit of the resection. This being done, the whole mass of the loosened growth with the pyloric portion of the stomach is then taken in the left hand and held well forward, so that both surfaces of the stomach are seen, while a large clamp (Kocher's special clamp, or my own largest stomach clamp) is then applied from the



FIG. 588.—PARTIAL GASTRECTOMY FOR CARCINOMA OF THE PYLORUS.

The operation is completed; the sutured stomach is shown infolded by means of the continuous Dupuytren stitch, the Halsted stitch being shown at the upper and lower ends. The duodenal end has been infolded by means of Halsted sutures. The position of the posterior gastro-enterostomy is shown.

lesser curvature just below the esophagus to the greater curvature at the point which has been reached in the omental ligation. This clamp has its blades covered with rubber. It is closed sufficiently to insure a firm grip upon the stomach. About half an inch beyond it a similar naked clamp is applied and pressed home as firmly as possible. Between these two clamps the stomach is now divided. At first the serous and muscular coats only are divided, back and front, and then subsequently the mucous coat. If the division of all the coats is simultaneous, the mucosa is apt to pout a little obtrusively. A difficulty is sometimes encountered at the lesser cur-

vature at this point owing to its tendency to withdraw from the clamp. If it should offer to do this, a couple of clips may be placed upon it, distal to the clamp, or, what is better, the through-and-through suture is started at once at this end.

The sutures which are now passed to close the stomach are two—an inner, which is occluding and hemostatic, embraces all the coats; an outer, which infolds the inner, is seromuscular only. The inner suture may be of No. 2 iodized catgut, or of Pagenstecher thread; the outer should be of thread. Both are passed with a curved needle. (Some operators here, as elsewhere, prefer a straight needle, but the curved needle, when one is accustomed to it, is the speedier.)

The inner suture commences at the lesser curvature, where it is securely knotted, and continues uninterruptedly to the greater curvature. I prefer the ordinary continuous through-and-through suture, for bleeding almost certainly occurs from the cut surface of the stomach when the clamp is loosened, and if the mucosa is infolded by a Connell suture the blood escapes into the stomach; whereas, by the suture I use, the mucosa is not infolded but only apposed, and bleeding from it is at once perceived and easily arrested. The clamp is now loosened from the stomach and any bleeding points separately secured by a through-and-through stitch. The next point is to make certain that the upper and lower parts of the cut stomach are well infolded. This is not entirely easy, owing to the thickness and retraction of the stomach. I therefore, before beginning the outer continuous supporting stitch, usually pass a Halsted suture at the extreme upper end, and sometimes also at the extreme lower end of the incision. When the edges at these parts are well rolled in, the continuous Dupuytren linen stitch is passed from the lesser to the greater curvature. The stomach when now inspected shows a suture line extending from within half an inch of the end of the esophagus to the greater curvature; the line of section seems a direct continuation downward from the right margin of the gullet.

At this stage in the operation it only remains to restore the continuity of the intestinal canal. This may be done in three ways: (1) By uniting the cut end of the stomach, reduced in size by suture, to the cut end of the duodenum ("Billroth's first method"). (2) By closing both ends and performing a separate gastro-enterostomy ("Billroth's second method"). (See Fig. 588.) (3) By closing the stomach and uniting the cut end of the duodenum to the posterior surface of the stomach ("Kocher's method").

Some operators perform all three methods in different circumstances. I prefer Billroth's "second method," for if a free removal of the stomach and duodenum has been made, it is often difficult and sometimes impossible to secure an end-to-end anastomosis. The approximation of the duodenum to the stomach is made easier after the duodenum has been "mobilized" by stripping up the peritoneum on its outer side.

In certain cases the operative procedure may be varied from this. The gastro-enterostomy may be performed first, a part of the stomach being chosen that would be left if a resection were done. Then when this is completed the resection may be performed in the manner already described, if the patient's condition justifies it.

Or the gastro-enterostomy may be done after the omenta and the duodenum are divided and just before the stomach is cut through. In a doubtful case the resection may be postponed for two or three weeks; during this time the patient, taking food freely, will gain in health and strength and be the better able to withstand the removal of the growth. It is said that patients are reluctant to face a second operation when they are feeling so much better after the first, but I have never encountered any opposition to such a course.

Carcinoma of the Body of the Stomach.—There are cases, few in number, it is true, in which the growth begins in the body of the stomach and causes an hour-glass constriction. In such cases the affected area may be cut out, and the openings on each side closed by suture. The details of the operation follow the lines laid down above.

Carcinoma of the cardiac orifice of the stomach does not lend itself to successful radical treatment. In all such cases gastrotomy or jejunostomy when the growth has extensively invaded the stomach are alone possible as palliative measures.

GASTROTOMY.

Gastrotomy is the operation in which the stomach is opened for the purpose of removing from it, or from the lower end of the gullet, a foreign body impacted therein, or with the object of investigating the interior in cases of ulcer attended by bleeding. It is also performed in rare instances of stenosis of the esophagus when a dilatation of the stricture from below is thought necessary. When these purposes are fulfilled, the wound in the stomach is closed and the viscus is returned within the abdomen.

1. Gastrotomy for the Removal of Foreign Bodies from the Stomach.

This is one of the most ancient of the operations upon the stomach. The first case recorded was operated upon by Mathis in 1602; the patient was a juggler, who fifty days before had swallowed a knife. Adhesion of the stomach to the anterior wall was secured by the application of "irritant plasters," and through the adherent wall the knife was removed. The result was successful. The following extract from "Evelyn's Diary" is of interest: "But amongst all the rarities of this place (Leyden) I was much pleased with their anatomy school, theatre, and repository adjoining, which is well furnished with natural curiosities: skeletons from the whale and elephant to the fly and spider, which last is a very delicate piece of art to see how the bones, if I may so call them of so tender an insect, could be separated from the mucilaginous parts of that little animal. Amongst a great variety of other things I was struck the knife newly taken out of a drunken Dutchman's gullet by an incision in the side after it had slipped from his fingers into his stomach. The pictures of the dissections, and of the patient's last days, were rare."

Cases to the number of twenty were recorded by Credé.¹ Maurice Richardson

¹ *Credé's* *Essai sur la gastrostomie expérimentale*. Paris, 1866, pp. 173.

² Richardson, *Journal of the Royal Society of Medicine*, *Series of Foreign Bodies and Removal of Stomach Contents*. London, 1888, pp. 100, 101.

published a list of thirty-two cases. The most important paper is that of Friedenwald and Rosenthal,¹ wherein all the cases from the literature are abstracted, and others not before published are also given, to the total number of ninety. For many of the following particulars I am indebted to this article.

In the ninety collected cases one foreign body was found in sixty-eight instances, more than one in the remainder. The majority of the foreign bodies were of metal, and were swallowed either in fits of insanity or during acts of display for the purposes of obtaining a livelihood. The most common among them were nails, knives, spoons, forks, safety-pins, hair-balls, stones, buttons, and keys. The most remarkable foreign body was a complete pair of braces. Kortmann² relates the case of a painter who had two shellac stones weighing 670 grams in the stomach for over sixteen years. Hair-balls, which often are of large size, forming as it were a cast of the stomach, are made up of hair pulled by the patient from her own head, or, rarely, of the hairs from animals, notably the cow or the horse. The hair is closely felted, being worked up into a solid mass by the action of the stomach. The ages of the patients in the ninety cases are as follows:

	MALES.	FEMALES.
Under 1 year.....	0	1
1 to 10 years.....	0	3
10 to 20 ".....	7	7
20 to 30 ".....	15	15
30 to 40 ".....	14	6
40 to 60 ".....	5	3
60 to 80 ".....	1	1

Adhesions were present in thirteen cases; in six an abscess was found to point on the anterior abdominal wall; in three perforation of the stomach, ending fatally, was caused.

The *symptoms* caused by a foreign body are, as a rule, few and devoid of special significance. In some a tumor has been observed, its exact nature being revealed only at the time of operation. The symptoms most usually recorded are pain, vomiting, loss of appetite, weakness. Kränzle, quoted by Friedenwald, remarks: "The condition of the patients shortly before the operation is in no wise proportionate to the severity of the changes which are found in the stomach, which shows plainly how little one can depend upon the stomach symptoms in these cases in forming a picture of how far the stomach has become actually diseased." Symptoms, then, are few and inconspicuous. A localized tumor is usually the cause of operation. Of the ninety cases recorded, seventy-one have been operated upon in recent years, and the success has been considerable, over 90 per cent. of the patients recovering.

Operation.—The operation is commenced by opening the abdomen through a long median or slightly lateral incision. The stomach, being exposed, is drawn well into the wound and the peritoneal cavity is walled off in the usual way by a

¹ Friedenwald, Julius, and Rosenthal, L. J.: "A Statistical Report of Gastrotomies for Removal of Foreign Bodies from the Stomach," New York Med. Jour. and Phila. Med. Jour., 1903, ii, 110.

² Vonnegut: "Ein Fall von Schellacksteinen in menschlichen Magen," Deut. med. Woch., 1897, xxiii, 26, S. 418.

series of swabs or by gauze. A vertical incision is then made through all the coats of the stomach, the incision being so placed as to avoid, as far as possible, any injury to the larger branches of the vessels. Bleeding is always free and is arrested by the application of a series of clips. The foreign body is then extracted in the manner which seems best, a small body being seized in forceps, a larger mass being turned out with the hand. The wound in the stomach is then closed by a double row of continuous sutures, the inner embracing all the coats, and infolding the mucosa, the outer seizing only the serous and muscular layers. The swabs are then removed and the abdomen closed.

2. **Gastrotomy for the removal of foreign bodies in the lower end of the esophagus** had been performed with great success on a few occasions. The best recorded case is that of Maurice Richardson.¹ The patient was a man who had swallowed a denture bearing four teeth, eleven months before; this had become impacted in the lower end of the esophagus. After the stomach had been opened the hand and forearm were inserted into the stomach, and the cardiac orifice of the stomach discovered. The plate was felt impacted about 2 inches above the diaphragm; it was detached and withdrawn, and the stomach wound carefully closed. The case proved most successful. The conclusions with regard to the operation which were formulated by Richardson were: that the oblique incision below the margin of the ribs is the best; that the stomach after being withdrawn from the abdomen a little should be opened to the right of the convexity of the lesser curve; that the assistant by traction on the stomach should put the lesser curvature on the stretch, and that the sulcus so formed is always a guide to the cardiac orifice.

3. **Gastrotomy for Exploration of the Stomach Interior.**—This is chiefly necessary in cases of hemorrhage from an ulcer, when the bleeding is recurring in such quantities and at such intervals as to threaten life. It has also been performed in cases of pedunculated tumors of the stomach accessible only from within.

In all cases of exploratory gastrotomy it is essential, as first pointed out by W. W. Keen,² that the stomach should be well washed out, and emptied, and before it is opened it should be brought out of the abdominal cavity and well walled off by gauze, so that the operation is practically extraperitoneal.

The stomach is opened on its anterior surface by either a vertical or a transverse incision. The latter is preferable, for though hemorrhage is perhaps more severe, a far better view of the interior of the organ can be obtained. The cut edges of the stomach are held wide apart by clips or fine vulsella, and any fluid seen in the stomach is mopped away. A speculum is then introduced into the stomach and the mucosa inspected, or, as is far better, a small incision is made through the gastrocolic omentum, or even through the transverse mesocolon, and the mucosa of the stomach inverted through the anterior incision. As the fingers are moved from one part of the stomach to another the greater part of the mucous membrane is passed

¹ Richardson, Maurice H.: "A Case of Gastrotomy, Digital Exploration of Esophagus and Removal of Plate of Teeth, Recovery," *Boston Med. and Surg. Jour.*, 1886, ii, 567

² Keen, W. W.: *Cartwright Lectures on the Surgery of the Stomach*, 1898, *Phila. Med. Jour.*, 1898, i, 829.

under review. If an ulcer is found, it is excised or cauterized, or sutured from within as seems best. It is generally necessary also to suture the area involved from the serous surface only, a few infolding Lembert sutures being used.

4. **Gastrotomy for the purpose of assisting in the dilatation of an esophageal stricture** has been occasionally found very useful. Gissler¹ collected ten cases and Kendal Franks² twenty-one cases, all the patients recovering. Dilatation can be done by two methods: "(1) By immediate dilatation or division, if the stricture is suited to this procedure. In this case the stomach and the abdomen are immediately closed. If, however, a large portion of the esophagus is constricted and repeated dilatation, a little at a time, is required, then (2) a temporary gastric fistula is established, and later, when the dilatation is accomplished, the fistula either closes spontaneously or is closed by a plastic operation."³ Hagenbach⁴ opened the stomach and attached it to the anterior abdominal wall. Then the patient was given a small shot, threaded on a string, to swallow. This when it reached the stomach was drawn out of the fistula, and to the fine thread a stout one was attached, and drawn upward to the mouth; by means of the stronger thread bougies were pulled through the stricture. Abbe⁵ has suggested a very ingenious method. A string is passed through the stricture from the mouth, or, better, from an opening made into the esophagus from the neck, and brought out through a gastric fistula. The stricture is then put on the stretch by a bougie passed into it, and the string is pulled backward and upward, sawing into the stricture. Kendal Franks passed Otis' urethrotome upward into the stricture through the cardiac orifice and dilated in that way.

A few cases of gastrotomy for the removal of pedunculated tumors are recorded. Chaput⁶ gives details of a case of pedunculated adenoma excised from the posterior wall in this way. Lyman⁷ opened the stomach of a man of sixty by an incision 5½ inches long, and removed a solid mass of adenocarcinoma whose diameter was 5 inches. Bennett⁸ removed a simple papilloma that occluded the pylorus from time to time, and led to intermittent dilatation of the stomach. The patient was cured.

¹ Gissler, J.: "Ueber die retrograde Dilatation von Oesophagus-Stricturen," *Beit. z. klin. Chir.*, 1892, viii, 109.

² Franks, Kendal: "Fibrous Stricture of the Oesophagus Treated by Gastrotomy and Retrograde Dilatation," *Ann. of Surg.*, xix, 385.

³ Keen: *Loc. cit.*

⁴ Hagenbach, Carl: "Casuistische Beiträge zur retrograden Dilatation von Oesophagus-Stricturen," *Correspondenzblatt. f. Schweiz. Aertzte*, 1889, Nr. 5.

⁵ Abbe, Robert: "A New and Safe Way of Cutting Oesophageal Strictures," *Med. Rec.*, 1893, xliii, 225.

⁶ Chaput, H.: "Adénome de la paroi postérieure de l'estomach," etc., *Bull. et Mem. Soc. de Chir.*, 1894, xx, 452.

⁷ Lyman, C. B.: "Report of a Case of Gastrotomy for Removal of a Pedunculated Carcinoma of the Stomach," *Ann. of Surg.*, 1896, xxiv, 310.

⁸ Bennett, W. H.: "A Clinical Lecture on Some Cases of Dilatation of the Stomach Considered from a Surgical Aspect," *Brit. Med. Jour.*, 1900, i, 243.

GASTROSTOMY.

Gastrostomy is the operation in which an artificial opening is made directly into the stomach for the purpose of allowing the introduction of food, in cases where the esophagus is rendered impassable by disease, or in order to permit an esophageal stricture to be treated by certain special methods, *e. g.*, Abbe's, Kraske's.

History.—The operation was suggested, though never performed, by Egeberg, a Norwegian military surgeon. He spoke of the possibility of making "an opening into the stomach for the purpose of injecting a sufficient quantity of food, or for treating an esophageal stricture from below." The first operation upon man was performed on November 13, 1849, by Sédillot; the patient died in a few hours. In this operation the stomach was opened at once, but in a second case, operated upon on January 21, 1853, Sédillot divided the operation into two stages, attaching the stomach to the abdominal wall first, and allowing it to become fixed there before opening it. In 1875 Sidney Jones, of St. Thomas's Hospital, operated with success, the patient living twenty days. Verneuil in 1876 operated upon a patient who lived for sixteen months. In its early days the operation was a most unsatisfactory one, for the opening was both an inlet and an outlet; food could be introduced freely into the stomach, but with equal freedom it escaped; gastric juice also leaked from the wound and made haste to digest the skin of the abdomen, which became intensely sore. Upon the exquisitely tender surface of the abdomen leakage was constantly pouring, and the most intense suffering was caused. In recent years a variety of methods have been suggested, having for their object the making of an opening which shall be valvular, allowing ready entrance to the food, but offering an obstacle, wholly or almost wholly, impassable to the fluid contents of the stomach.

Conditions for which the Operation may be Done.—1. *Malignant Disease of the Esophagus.*—This is the chief indication. In these cases the patient is suffering gradual starvation by reason of the increasing narrowness of the esophagus. The growth in the gullet may be at the upper end, at the lower end, or at the point where the left bronchus crosses just below the bifurcation of the trachea. It is probable that the latter is the most frequent, though it is not seldom stated that the lower end is most commonly affected; this is due to the fact that those cases of growth in the cardiac end of the stomach are also included. The latter are, however, glandular carcinomata, the esophageal growths being squamous carcinomata; in rare instances columnar epithelioma is found, having its origin no doubt in the epithelium of the esophageal glands.

2. *Carcinoma of the Cardiac End of the Stomach.*—The symptoms caused by this are similar to those which result from cancer of the esophagus, but a bougie will pass usually over 15 inches beyond the teeth before being arrested when the obstruction is in the stomach.

3. *Simple Stricture of the Esophagus.*—This is almost invariably fibrous in character, and results from the cicatricial contraction occurring in ulcers which have been caused by the swallowing, by accident or with suicidal intent, of caustic

fluids. The position in which these strictures are found is identical with that which obtains in cases of malignant disease; but the lower end of the gullet is without doubt much more commonly affected than any other part. In simple stricture of the esophagus the operation may be performed for one of two reasons: either to permit of retrograde dilatation of the stricture by Abbe's method or Kraske's method, or to allow the patient to be fed artificially.

4. *In cases of Recent Scalding of the Esophagus or Stomach by Caustics.*—In these cases the operation of gastrostomy is combined with that of gastro-enterostomy (q. v.). A similar combination of the two operations has been suggested for cases of acute hemorrhage from ulcer

of the stomach; and by Neumann for cases of intense hyperacidity.

The most debatable point in connection with the operation of gastrostomy in cases of malignant disease of the esophagus or cardia has reference to the stage of the disease in which the operation should be performed. In earlier days the operation was attended by such grave disadvantages that it was only when the patient was on the brink of starvation that the surgeon felt entitled to urge the performance of the operation. But with the modern "valve" operations there can be no hesitancy in advising operation as soon as the patient is beginning seriously to suffer from lack of food. When the diet by slow degrees has been curtailed till only fluids are taken, and these with some difficulty, on account of regurgitation, then operation must no longer

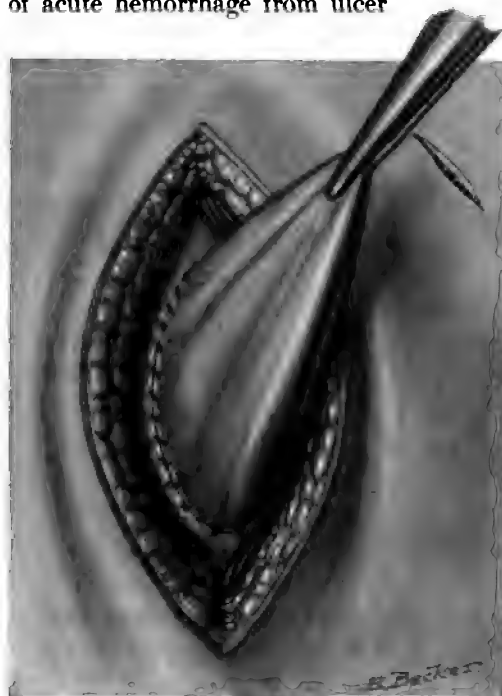


FIG. 589.—FRANCK'S METHOD OF GASTROSTOMY.

be delayed. If the patient suffers much from the constant regurgitation of mucus,—and this is sometimes most distressing,—operation may be performed earlier. It is better to perform gastrostomy too early than too late, for the discomforts and risks of the operation in the former case are negligible. If need be, the operation can be performed under local anesthesia. There are several methods of performing gastrostomy; the chief of these are: (1) Franck's method ("Sbanajew-Franck," "Albert-Franck," or "Albert-Franck-Kocher"); (2) Witzel's method; (3) Senn's method; (4) Dépage's method.

Franck's Operation.—An incision about 2 inches in length is made parallel to the left costal margin, and one inch below it, just below the edge of the liver. The incision is made in a vertical direction by many surgeons and is equally satisfactory.

As soon as the abdomen is opened the stomach is sought and a part of its anterior wall is grasped and pulled well up into the wound, until a cone-shaped part of it protrudes. The part of the stomach pulled out is as near the cardia as possible; it is fixed at its base to the parietal peritoneum by a running suture or by several interrupted sutures (Fig. 589). A second incision over the costal margin is now made, about $\frac{3}{4}$ to 1 inch in length, distant about one inch from the margin. Between this incision and the original incision the skin is dissected up until a bridge is left by it, free at each side, attached at each end. Beneath this bridge the stomach cone is passed until its apex protrudes through the second smaller incision, where it is fixed by three or four sutures. The original wound is then closed (Fig. 590). The nipple-like projection of the cone is then opened at once or later, and a catheter passed for feeding purposes.

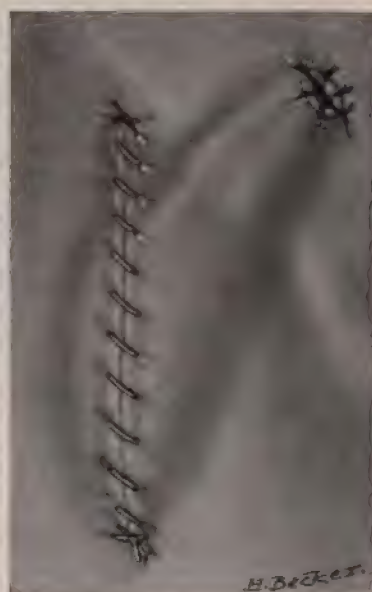


FIG. 590.—FRANCK'S METHOD OF GASTROSTOMY.



FIG. 591.—WITZEL'S METHOD OF GASTROSTOMY.

Witzel's Method.—The object of this operation is to form an oblique tunnel

in the walls of the stomach. A vertical incision two inches in length is made through the upper part of the left rectus, and the muscle split. The anterior wall of the stomach is pulled well into the wound, and a small opening made into it about the middle, near the greater curvature. A tube is passed into this opening and fixed by a catgut suture. The tube is then laid flat upon the surface of the stomach, and a suture is taken through the serous and muscular coats of it from one side to the other until a ridge is raised up on each side, and the ridges meeting across the top of the tube bury it in a gutter. The suture begins about $\frac{1}{2}$ inch beyond the point where the tube enters the stomach, so that there is no fear of leakage there. The method is a most satisfactory one. (See Fig. 591.)

Senn's Method (E. J. Senn).—This is the method I prefer to all others; it is simple, perfectly effective in preventing leakage, and is more rapidly performed than any other. A vertical incision is made over the left rectus muscle near its outer border, commencing a little below the level of the tip of the xiphoid cartilage, and continuing downward for about 2½ inches.



FIG. 592.—SENN'S METHOD OF GASTROSTOMY.

The fibers of the rectus muscle are separated, not divided, and the peritoneal cavity is opened. If the separation is done by the finger covered by gauze, no nerves will be divided. The stomach is then sought and is easily recognized. It is said that the transverse colon has been mistaken for the stomach and has been opened; one would think that such a mishap is impossible, for there is not the slightest resemblance between the two viscera. The stomach is generally found at once, but, owing to the fact that it is often thin-walled and shrunken from long suppres-

sion if its normal activity, it may lie flaccid and empty at the back of the stomach chamber, with the transverse colon in front of it. When the colon is displaced downward, it comes at once into view. It is picked up, drawn forward to the parietal incision, and a portion of it, as far removed as possible from the pylorus, is selected for the operation. A point about midway between the lesser and the greater curvature is chosen for the site of the opening into the stomach. At this point a small incision is made with a scalpel, of sufficient size to admit a No. 10 or 12 Jacques catheter or a piece of drainage-tube of about the same diameter. The catheter or tube is passed into the stomach through this opening for a distance of about two or three inches, and is then fixed by a single catgut stitch which passes through all the coats of the stomach, at the edge of the incision, and then picks up a part of the tube (Fig. 592). When this stitch is tightened, the tube is held fast and remains so held until the catgut is absorbed—or cuts through—in about ten days.



FIG. 593.—SENN'S METHOD OF GASTROSTOMY.
SECOND STEP.

The tube so fixed is now buried in an inverted cone formed from the walls of the stomach by the insertion of three purse-string sutures. The first purse-string suture is applied in a circle whose center is the tube, and whose radius is about half an inch. The suture picks up the stomach-wall at about six points. As it is tightened, the tube is depressed into the stomach by an assistant whose other hand holds the stomach steady, so that when tied, the suture closely embraces the tube. A second suture is now introduced at a distance of half an inch from the tube, picking up the stomach wall at seven or eight points. As it is tightened and tied, the tube is again pushed inward so that the suture again embraces the tube closely. A third, and if necessary, a fourth, suture can be similarly introduced. The result is that a cone of the stomach is inverted into the cavity of the organ; and in the center of this cone there lies the tube or catheter, closely embraced by the outer wall of the stomach. The stitches are all tightened with sufficient firmness to embrace, though not to constrict, the tube. When the last stitch has been cut short, two sutures are passed above and below the tube in order to fix the stomach to the parietal peritoneum. The sutures include the posterior sheath of the rectus and parietal peritoneum on each side, and pick up a broad strip of the stomach about $\frac{3}{4}$ inch distant from the tube. They serve to draw the stomach up to the parietal incision and to fix it there firmly.

Dépage's Method.—In this method a tube is made out of the anterior wall of the stomach, and through it the food is conducted. A vertical incision through the rectus muscle is made and the abdomen opened. A large part of the stomach is drawn up into the wound and is stitched all round to the edge of the parietal peritoneum. A flap with its base upward is then cut out of the anterior wall of the stomach. This is done by pinching up a fold of the wall between long pressure forceps, and cutting along the edge of the blades. The flap is then turned upward, and the incision in the stomach is closed by a continuous suture passed at first only through the mucous coat, and carried up along the flap which has been raised. Outside this suture a second, picking up the serous and muscular coats, is passed at first along the edge of the wound in the stomach and then along the tube, which has now a complete serous covering. The canal thus made is fixed to the abdominal wound, or may be passed, if long enough, beneath a bridge of skin, as in Franck's method.

In all the operations it will be found that the stomach is small and contracted, the result of long curtailment in the amount of food which has been taken.

After-treatment.—The patient may be fed at once on the completion of the operation, with milk, beaten egg, and brandy. As a rule, food should then be given



FIG. 594.—SENN'S METHOD OF GASTROSTOMY.

in small quantities frequently, because of the small size of the stomach. As a rule, 6 ounces every three hours is enough; to be later increased in quantity, the intervals being lengthened. It is often found that after a few days the patient can swallow better, sometimes very much better, than before the operation. It is wise to allow patients to drink a little of their favorite beverage, and to masticate food which may be ejected afterward. All forms of fluid may be given, the more nutritious being chosen; and an occasional washing out of the stomach through the tube gives comfort.

Prognosis.—The immediate results of the operation are good. I have only lost one patient in thirty-one operations, and that was a case early in my experience, performed when the patient had not swallowed a drop of fluid for several days. The ultimate outlook, of course, is hopeless; but patients live their days in comparative comfort, free from the torture of thirst. The operation lengthens the patient's life; but, what is vastly more important, it brings relief from suffering and from the indescribable horror of thirst and starvation.

GASTROPEXY.

Gastropexy is the operation by means of which the stomach which has fallen low in the abdomen is replaced in its normal position and sutured there.

The treatment of the prolapse of the stomach by operation was first suggested by Duret,¹ of Lille. The condition of descent of this organ may exist alone or it may be merely a part of that general enteroptosis which is usually described as "Glénard's disease." Rovsing, of Copenhagen, and Beyea, of Philadelphia, have given special attention to this subject.

Rovsing describes two forms of gastropoptosis: (1) That which he describes as "virginal," which is the rarer, but which is the more important, since the great majority of cases needing operation belong to this class. The abdominal wall is firm and strong. (2) That which occurs in multiparous women; it is often accompanied by considerable prolapse of other viscera, causes little pain, and is often relieved by well-fitting bandages.

Bandages are of no value in the "virginal" form because the abdominal wall, being sound, does not allow adequate, properly directed, pressure to be exerted by any external appliance.

Rovsing has operated upon forty-nine cases; forty-four belonged to the "virginal" class, five to the "multiparous." In only six of the cases was there gastric stasis. All the patients recovered from the operation, and all were relieved, with the exception of one case where there was also a narrowing (unnoticed at the time) of the duodenum due to old adhesions. In one case gastropexy was combined with hepatopexy; in another, removal of the extremity of an enlarged left lobe of the liver was also performed.

The cases of prolapse of the stomach alone that I have been called upon to treat

¹ Duret, H.: "De la gastropexie," *Rev. de Chir.*, 1896, xvi, 421.

are singularly few, not more than three in all, though I have been cognizant of the work done in this subject by Rovsing and others, and have given close attention to the matter. I am driven, therefore, to the belief that there can only rarely be any need for surgical treatment. It cannot be denied that the majority of patients who suffer from prolapse of the stomach are, with those who suffer from the similar condition affecting the kidney, of the type described as "neurotic." It is not the mere descent of one or more organs that is the disease, but rather a vice in all the parts which derive guidance from the abdominal sympathetic nervous system. To anchor one organ or many, in such circumstances, is of little value unless it is clear that the symptoms of which the patient makes complaint are in some measure due to the displacement of that organ or organs.

The following methods of performing the operation are recognized: (1) Duret's method; (2) Beyea's method; (3) Coffey's method; (4) Rovsing's method.

The preparation of the patient is the same as in all abdominal operations.

Duret's Operation.—A long incision is made in the abdominal wall from the ensiform cartilage to the umbilicus, down to the peritoneum. In the upper part of the wound the peritoneum is not incised, but is made bare on its anterior surface by detaching the rectus muscles from it. The lower part of the peritoneum is then divided and the abdominal cavity opened. The stomach is then sought. Through the stomach and the undivided peritoneum in the upper part of the wound a suture is passed. In Duret's original operation the suture was of silk and was continuous. The suture is passed at first through the left edge of the parietal incision through fascia, rectus muscle, and peritoneum, and then horizontally through the serous and muscular coats of the stomach close to the lesser curvature. The needle is now passed from within outward through the uncut peritoneum, and then back into the abdomen again to pick up the stomach as before. A series of similar loops are made in the suture which is passed along the greater part of the lesser curvature of the stomach. As soon as the stitch is tightened the stomach is strung up and fixed. Duret's first case did well, and the patient, a married woman, who has suffered severely for three years from gastropexy, was completely relieved, and in two years had gained 25 pounds in weight.

Beyea's operation is, in my judgment, the most satisfactory of all methods. Beyea¹ gives the following description of it:

"An incision about three inches in length was made through the linea alba, midway between the xiphoid cartilage and umbilicus. The tissues were separated in the usual manner and the peritoneal cavity opened, exposing a small portion of the lesser curvature and cardiac end of the stomach, the gastrohepatic ligament or omentum, gastrophrenic ligament, and the lower portion of the left lobe of the liver. The table was then elevated to the Trendelenburg position and the stomach displaced still further downward and out of the wound by means of gauze sponges. This

¹ Beyea, Henry D.: "The Elevation of the Stomach in Gastropexy by the Surgical Plication of the Gastrohepatic and Gastrophrenic Ligaments: An Original Operation," *Phila. Med. Jour.*, 1903, i, 257.

procedure caused the gastrohepatic and gastrophrenic ligaments to be slightly stretched, and separated from the underlying structures, which permitted an accurate determination of the length of these ligaments and very much facilitated operative manipulations. The gastrophrenic ligament was seen well developed, and evidently formed a strong support to the cardiac end of the stomach. The joining portion of the gastrohepatic ligament was composed of thin, delicate peritoneum, increasing in thickness and strength toward the right or pyloric end of the stomach. Retractors were introduced and the liver held aside by placing a gauze sponge beneath a retractor. Three rows of interrupted silk sutures were then introduced so as to plicate and thus shorten the gastrohepatic and gastrophrenic ligaments in the following manner.



FIG. 595.—BEYEA'S METHOD OF GASTROPEXY.

The first row, beginning in the gastrophrenic ligament, and extending across the gastrohepatic ligament to almost opposite the pyloric orifice and hepaticoduodenal ligament, was introduced so as to form a plication in the center of these ligaments, and included from above downward or vertically about 4 cm. of tissue (row No. 1). They were practically mattress sutures, including sufficient of the delicate tissue (1 cm.) to insure against their tearing out. Five sutures, about one inch apart, were introduced from right to left and caught in hemostatic forceps. The next row (row No. 2) of sutures was introduced in the same manner,

but 2.5 cm. above and below the first two. Then a third row (row No. 3) was introduced just above the gastric vessels and a short distance below the diaphragm and liver. The suturing was strictly confined to the normal ligamentary supports, and the distance between the rows from left to right was increased with the length of the ligaments, being greater toward the right. The gauze sponges were then removed, and the first, the second, and finally the third row of sutures were secured, the stomach, particularly the pyloric end, being elevated to a little above the normal position."

The sutures were of silk. Four successful cases are recorded. A similar opera-

tion has been performed by Bier. In a recent letter Beyea kindly informs me that he has operated in eight cases, with marked benefit in all. The first case remains well after eight years. I have only once performed the operation, and the result has been very good.

The advantage of the operation just described is that it does not fix the stomach to the anterior abdominal wall, and therefore does not interfere with the proper mobility of the organ.

Coffey's Method.—R. C. Coffey¹ describes a method of "suspending the stomach in a hammock made of the great omentum." When the abdomen is opened the stomach is freed from adhesions and pushed gently upward into its normal position. A series of chromicized catgut sutures are then passed transversely across the abdomen, picking up on the one side the great omentum one inch below the stomach and on the other the anterior abdominal wall. Coffey writes as follows:

"As to the technic, I think this can well be varied to suit the case in hand. If only the stomach is displaced and not much dilated, it will probably be sufficient to put one row of sutures across, about an inch below the attachment of the stomach. If the abdomen is much



FIG. 596.—BEYEA'S METHOD OF GASTROPEXY.

relaxed and the colon shows a decided tendency toward prolapse in splanchnoptosis, it will be probably well to put two rows of sutures across, penetrating the entire thickness of the omentum just below its attachment to the colon. In this way such a broad line of adhesion will be constructed that it will practically be impossible for the organs to become prolapsed.

"In my first case I placed three interrupted chromicized catgut sutures, covering a space of about 2 inches, near the center of that portion of the omentum attached to the dilated portion of the stomach. In my second case I used eight chromicized catgut sutures, covering a space a little more than 6 inches. In case of a very much

¹ Coffey, R. C.: "Gastropexy: a Method of Suspending the Stomach in a Hammock Made of the Great Omentum," Phila. Med. Jour., 1902, x, 506.

dilated stomach I would suggest extending the suture still farther, taking in 8 or 10 inches across the omentum. The stitches have been passed about $2\frac{1}{2}$ inches above the umbilicus and have been passed from a large longitudinal incision, as shown in the cuts."

I have once adopted this method and found it most satisfactory.

Rovsing's Operation.¹—In this operation three stout sutures of silk are passed transversely through the stomach, picking up only the inner coats. At each end the silk is tied over a glass rod, after being passed through all the layers of the abdominal wall. The stitches are removed at the end of four weeks, when the stomach is solidly fixed to the anterior abdominal wall.

PYLOROPLASTY.

BY J. M. T. FINNEY, M.D.

Operations that have to do with the enlarging of the diameter of a strictured pylorus have been suggested from time to time by various surgeons. These operations differ from each other both in the method of procedure and the size of the new pylorus.

Heineke² in 1886 first described a method for enlarging the pylorus by means of a transverse curved incision through the anterior wall of the pylorus, subsequently converting this into a vertical incision and uniting the edges by suture. The following year Mikulicz³ reported independently the same procedure, which has since borne their names.

Durante⁴ in 1894 reported a plastic operation upon the pylorus by means of a transverse V-shaped incision in the anterior wall. The Y incision is converted into a V by suturing the apex of the Y to its base.

Segale⁵ in 1900 suggested a crescent-shaped incision with the convexity downward. The edges are slid upon one another horizontally and sutured, thus giving a spiral effect to the new pylorus.

The author⁶ in 1902 reported a method which made use of a horseshoe-shaped incision through the pylorus, extending well down upon each side through the anterior walls of the duodenum and greater curvature of the stomach respectively, which are approximated and sutured much as in a lateral anastomosis.

¹ Rovsing, Thorkild: "Ueber Gastropse und ihre operative Behandlung," *Archiv. f. klin. Chir.*, 1900, lx, 803.

² Heineke: "Operation de Pylorusstenose," *Inaug. Dissert.*, Furth, 1886.

³ Mikulicz, J. v.: "Zur operativen Behandlung des Stenosirenden Magenschwures," *Arch. f. klin. Chir.*, 1888, xxxvii, 79-90; *Verhandl. d. deutsch. Gesellsch. f. Chir. Berl.*, 1887, xvi, pt. 2, 337-348.

⁴ Durante, F.: "Ueber Pylorusverschluss u. dessen Behandlung," *Central. f. Chir.*, 1894, xxi, 1077.

⁵ Segale, J. B.: "Procédé de pyloroplastie par glissement," *XIII Congrès Internat. de Med.*, 1900, x, 640.

⁶ Finney, J. M. T.: "A New Method of Pyloroplasty," *Bull. Johns Hopkins Hosp.*, July, 1902. "Three Years' Experience with Pyloroplasty," *Surg. Gyn. and Obst.*, 1906, ii, 2, 163.

Narath¹ in 1904 described two methods of pyloroplasty, the first of which consisted of the reflection downward of a flap taken from the anterior wall of the pylorus, duodenum, and stomach on either side. The edges of the incision are then sutured as in the Heineke-Mikulicz operation. This procedure is simply an exaggeration of that operation. His second method is practically the same as that described two years previously by me, differing only in extent.

Various methods of gastroduodenostomy have been described by Jaboulay,² Henle,³ Villard,⁴ Kocher⁵ and others, but since they do not include the pylorus, they will not be considered.

The name "pyloroplasty" has been retained in spite of certain objections that have been urged against the earlier procedures, because while involving an incision through the walls of both the stomach and duodenum, this operation concerns essentially the pylorus, and is in reality an enlargement of its diameter, necessitating its division in every instance; while gastroduodenostomy need not disturb the pylorus at all. Gastro-pyloro-duodenostomy would be a more correct term, but is objectionable on account of its length.

Of the various methods of pyloroplasty mentioned above, the author's operation, for obvious reasons, is the operation of choice, since it admits of an opening of any desired size.

The operation is described as follows:

If there are any adhesions present binding the pylorus to the neighboring structures, they should be freed as thoroughly as possible; also the pyloric end of the stomach and first portion of the duodenum. Upon the thoroughness with which the pylorus, lower end of the stomach, and upper end of the duodenum are freed, depends in a large measure the success of the operation and the ease and rapidity of its performance. I want to emphasize this as one of the most important points in the operation. Occasionally at first sight this may seem impossible, but with care and patience it is usually found that it can be accomplished with comparative ease. Kocher also lays stress upon the advantages to be gained from this "mobilization of the duodenum," as he calls it.

A suture to be used as a retractor is taken in the upper wall of the pylorus, which is then retracted upward by means of this suture. A second suture is then placed in the anterior wall of the stomach, and a third in the anterior wall of the duodenum at equidistant points, say about 10 cm. from the suture just described in the pylorus. The second and third sutures are taken as near the opposing free borders of the stomach and duodenum as possible, and mark the lower ends of the gastric and duodenal incisions respectively. Traction is then made upward on the pyloric

¹ Narath, A.: "Zwei Vorschläge zu Modification der Pyloroplasty." *Archiv. f. klin. Chir.*, 1904, lxxiv, 992.

² Jaboulay, Mathieu: "De la gastroduodenostomie," *Arch. Prop. de Chir.*, 1892, i, 551.

³ Henle, A.: "Ein Fall von Gastroduodenostomie," *Central. f. Chir.*, 1898, xxv, 753.

⁴ Villard: "Gastro-duodenostomie sous-pylorique." *Bull. Soc. de Chir. de Lyon*, 1900, iii, 95-100. *Lyon med.*, 1900, xciii, 522.

⁵ Kocher, T.: "Mobilisierung des Duodenum u. Gastro-duodenostomie," *Centralb. f. Chir. Leipz.* 1903, xxx, 33-44.

suture and downward in the same plane, on the gastric and duodenal sutures. This keeps the stomach and duodenal walls elevated and taut, and allows the placing of the subsequent sutures with greater facility than if they remained retracted and relaxed. The peritoneal surfaces along its greater curvature, are

walls elevated and taut, and allows the placing of the subsequent sutures with greater facility than if they remained retracted and relaxed. The peritoneal surfaces along its greater curvature, are

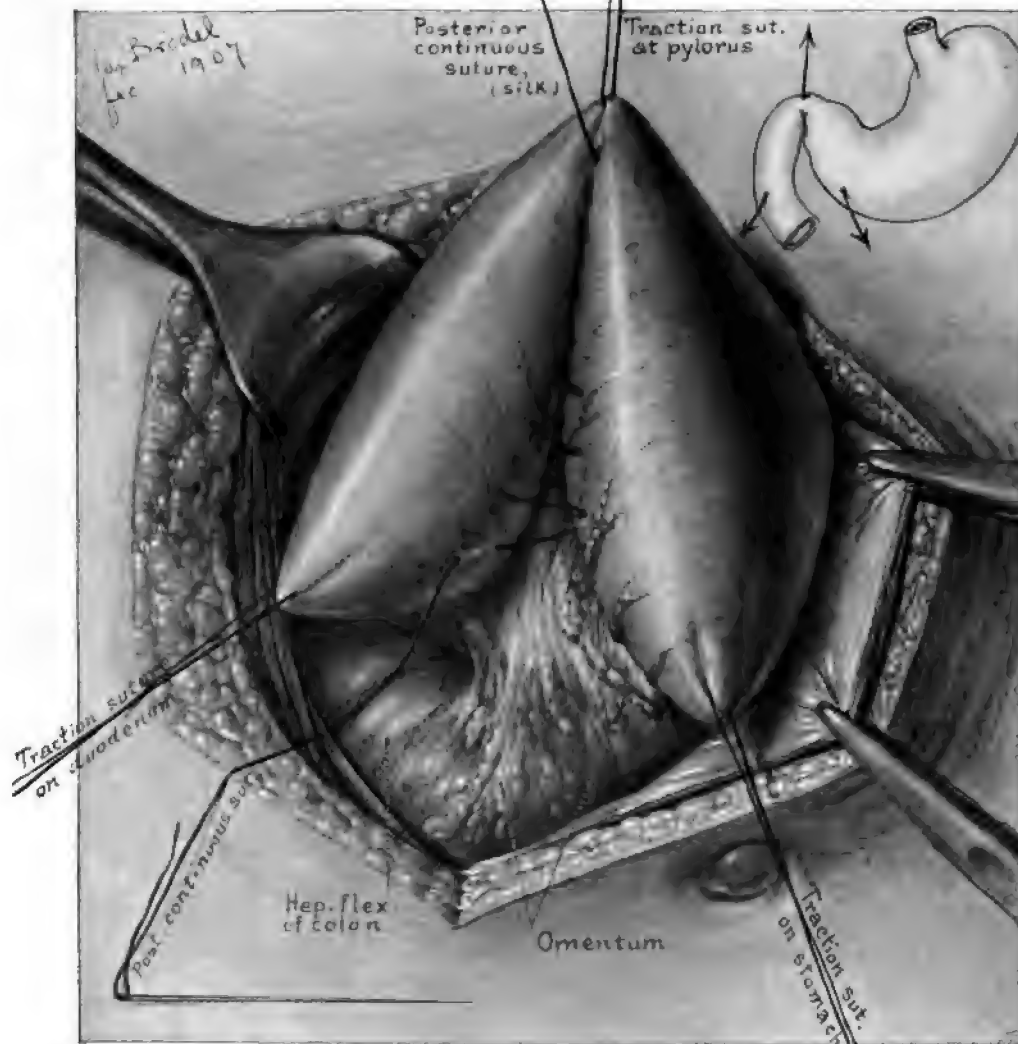


FIG. 597.—SHOWING TRACTION STITCHES IN PYLORUS, STOMACH, AND DUODENUM. POSTERIOR LINE OF SUTURE NEARLY COMPLETED.

then sutured together as far posteriorly as possible. For this row the continuous silk suture is best. After the posterior line of sutures has been placed and tied, an anterior row of mattress sutures is taken, which are not tied, but left long in the manner indicated in the accompanying drawings of the operation (Figs. 598, 599).

These sutures, after they have been placed, are drawn aside, thus exposing the line of incision.

After all the anterior stitches have been placed and retracted, the incision is made in the shape of a horse-shoe. The anterior and posterior lines of sutures should be placed far enough apart to give ample room for the incision. Beginning in the gastric wall, the incision is carried up to and through the pylorus and around into the duodenum. Hemorrhage is then stopped. Scar tissue or active ulcers present in either the gastric or duodenal wall may be excised through this incision. Redundant mucous membrane may also be excised. A continuous catgut suture is now taken through all the coats of the stomach and duodenum, on the posterior side of the incision, in order to reinforce this line of sutures. The anterior sutures are then straightened out and tied, and the operation is completed. The mattress sutures may be reinforced with as many Lembert sutures as may be thought best. All the stitches are thus placed and the posterior row tied before the bowel is opened, and it remains open just long enough to control the hemorrhage, thus giving the minimum of exposure of infected surfaces.

The size of the newly formed pyloric opening may be made as large or small as desired. In my cases the new pylorus has averaged 10 cm. in diameter. Unless the stomach is very much dilated or has descended to an unusual extent, the lower limit of the new pylorus will be found to be at or near the level of its most dependent part.



FIG. 598.—POSTERIOR CONTINUOUS SUTURE PLACED AND TIED. ENDS LEFT LONG AS RETRACTORS. ANTERIOR ROW OF MATTRESS SUTURES PLACED BUT NOT TIED.

This operation has been modified by Gould by the use of clamps, and it is so performed by most operators today, but this is a matter of choice on the part of the surgeon. An obvious objection to the use of clamps would be the inability to explore the inside of the stomach through the incision. His modification of the operation is as follows:

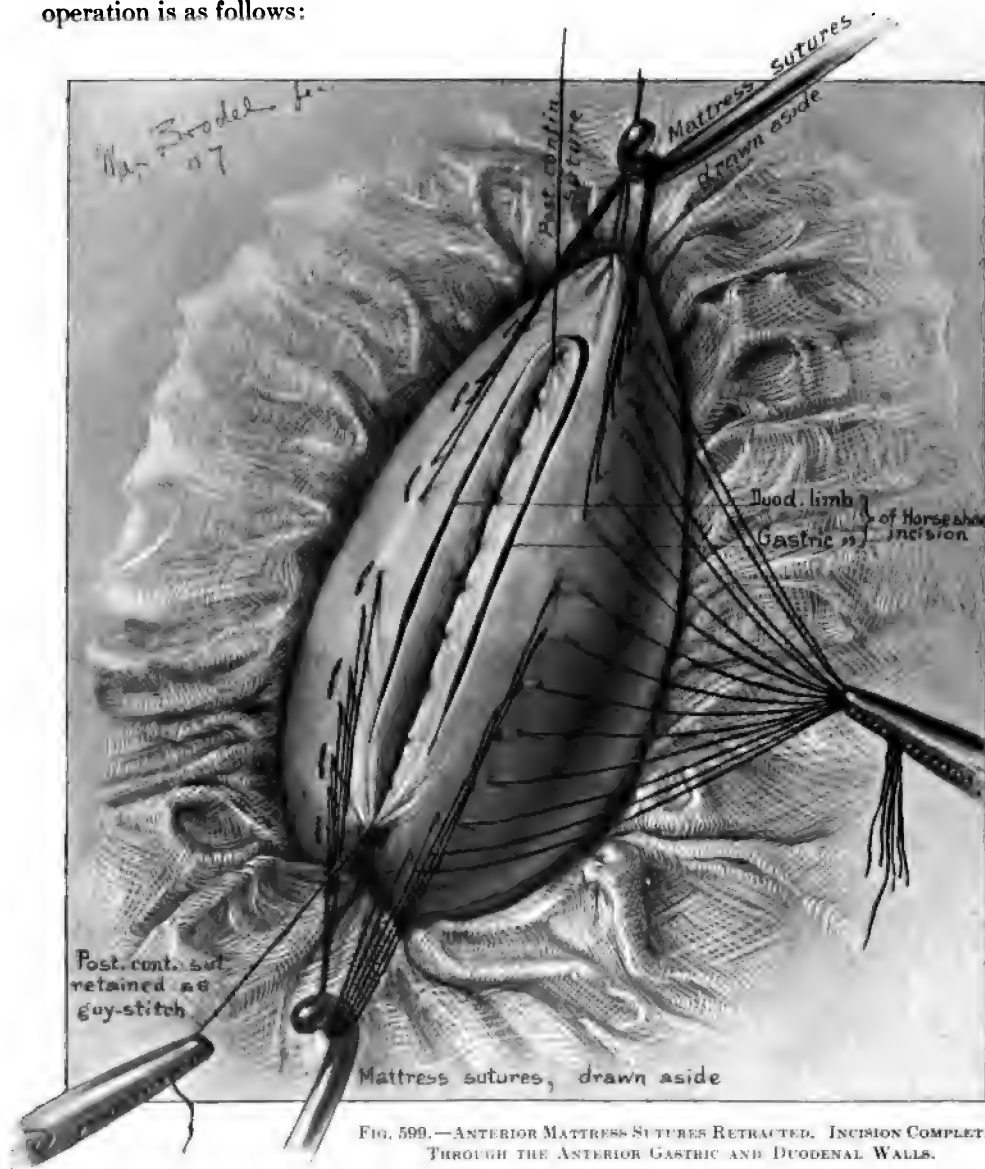


FIG. 599.—ANTERIOR MATTRESS SUTURES RETRACTED. INCISION COMPLETED THROUGH THE ANTERIOR GASTRIC AND DUODENAL WALLS.

When the duodenum is sufficiently freed clamps are applied. On the duodenum a fold of bowel about two and one-half inches long is taken up longitudinally, and the clamps pushed up until the inner jaw rests against the pyloric sphincter. On the stomach the clamp is placed in a similar manner, the point of the inner jaw

touching that of the duodenal clamp at the pylorus. The ends of the clamps are not freed, but grasp the bowel half an inch below the free edge. This places the clamps at right angles to the blood-vessels both of the stomach and of the duodenum. When the handles of the two clamps are brought together, the pyloric angle is put on the stretch, thus controlling hemorrhage and preventing leakage from this in-



FIG. 600.—ANTERIOR GASTRIC AND DUODENAL WALLS RETRACTED, SHOWING BUTTONHOLE SUTURE OF CATGUT PARTLY PLACED IN THE FREE BORDERS OF THE POSTERIOR WALLS.

accessible point. If the clamps are placed in the manner recommended above, the remainder of the operation will practically amount to a repetition of the gastroenterostomy technic. The folds are fastened together as they lie side by side, by the usual outer seromuscular stitch. This stitch starts at the pyloric angle, to make sure that this point is placed at the apex of the tongue to be cut out later.

The incisions into the bowel and the stomach are like those of gastro-enterostomy, except that they are joined at one end, an addition which is made possible by the continuity of the two organs. The stomach incision is carried down until the mucous membrane pouches between the cut muscular walls. The stomach incision is then left and the duodenum opened until the mucous membrane is met at the pyloric angle. The pouching mucous membrane is removed from the stomach by cutting with scissors close to one muscular edge, returning on the other

side. The completed incision leaves a tongue-like process made up of half stomach and half intestinal walls. The two edges of the tongue are next sewed together with a continuous through-and-through chromic stitch which starts at the apex of the tongue and goes across the cut to the base. At this point the suture is interrupted with a tie, after which the suture is continued around over the front and tied at the pyloric angle. It is necessary to loosen the clamps before placing the last few stitches of this suture, since this area is under too great tension to allow the edges to be brought together. The clamps are finally removed altogether and the suture buried in with a continuous seromuscular suture.



FIG. 601.—MATTRESS SUTURES PREVIOUSLY PLACED NOW TIED. ALTERNATE LEMBERTS PLACED BETWEEN THE MATTRESS SUTURES.

As compared with gastro-enterostomy, the objections urged against this operation

are its greater technical difficulties, especially in the presence of adhesions and dense cicatricial tissue about the pylorus; that it does not take advantage of gravity by making the new outlet of the stomach at its lowest point; that it is inapplicable in the presence of active and bleeding ulcers. These objections are more fanciful than real, since the operation has been repeatedly performed under these conditions, with most satisfactory results. The interesting experimental work of Cannon and Blake¹ supports this contention.

¹ Cannon, W. B., and Blake, J. B.: "Gastroenterostomy and Pyloroplasty," *Ann. of Surg.*, 1905, xli, 686.

On the other hand, certain disadvantages which have been observed in connection with gastro-enterostomy,—namely, vicious circle, peptic ulcer of the jejunum, subsequent closure or contraction of the anastomotic opening, etc.,—have not been

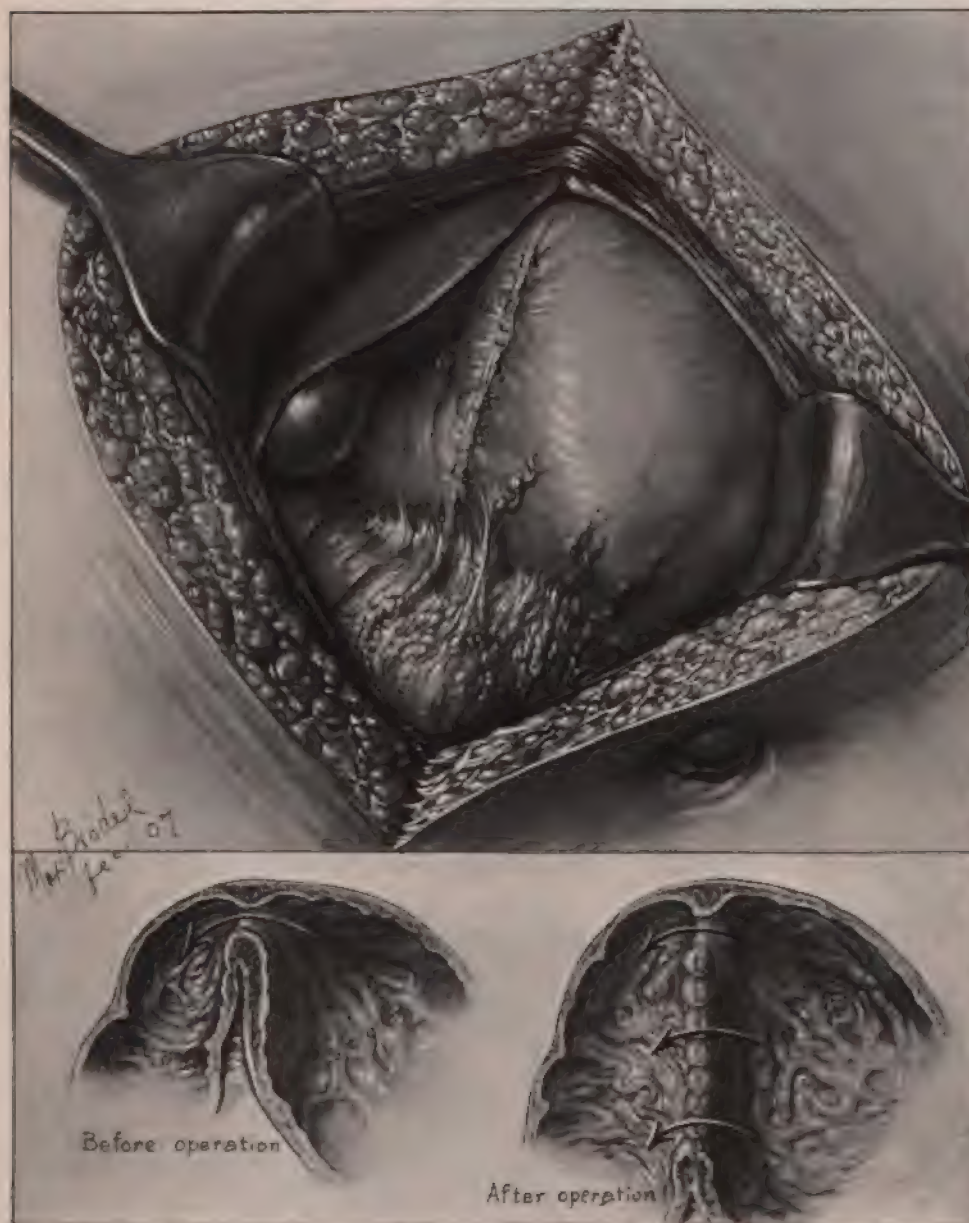


FIG. 602.—OPERATION COMPLETED. SHOWING RELATIVE SIZES OF OLD AND NEW PYLORUS.

observed. The mortality rate, too, is slightly in favor of pyloroplasty as against gastro-enterostomy. One of the satisfactory features of this operation is the almost

entire absence of post-operative nausea and vomiting, due, possibly, to the division of the pylorus. The endeavor has been made to determine as far as possible the limitations of the operation. It has been found in the author's experience, based upon fifty cases, that this operation offers greater advantages in pyloric stenosis of benign origin than does the operation of gastro-enterostomy. It has also been found to be just as efficacious as gastro-enterostomy in the presence of an active or bleeding ulcer. The one contraindication that has been so far determined is atonic dilatation of the stomach in nervous patients, particularly when associated with a dilated duodenum. For this particular condition, however, I am not familiar with any operative procedure which offers adequate relief.

CHAPTER XXXIV.

INTESTINAL SURGERY.

BY JOHN B. MURPHY, M.D.

MALFORMATIONS OF INTESTINE.

Congenital occlusion of the small intestine, while rare in any location, is most frequent in the duodenum; the next most common site is the ileocecal region. It may arise from several causes, the most important of which are: (*a*) intrauterine peritonitis; (*b*) amniotic bands; (*c*) ulceration; (*d*) persistence of the vitelline duct; (*e*) pressure from tumors outside the bowel; (*f*) embolism of the superior mesenteric artery; (*g*) volvulus; and (*h*) inguinal hernia, etc. An apparently very potent and not rare cause is disease of the fetal blood-vessels; obliterated vessels supplying organs cause either maldevelopment or even their total disappearance.

Cordes,¹ who collected fifty-six cases of congenital *occlusion of the duodenum*, in addition to one of her own, found the constriction more frequent in the neighborhood of the common bile-duct—just above it in twenty cases, and below it in thirteen cases. Total occlusions are more frequent than stenoses. In fourteen cases there was vomiting of meconium; in twenty-one the stools contained meconium and one was intermixed with blood. The length of life varied from thirty hours to nine days in total atresia, and from thirty hours to six months in stenoses. Herz² regards occlusion above the papilla of the bile-duct as scarcely distinguishable from pyloric stenosis, as there is enormous distention of duodenum and pylorus (Fig. 603). When the stenosis is below, the differential symptom of greatest significance is the presence of bile in the stomach, which in some cases is dilated. The stomach, whether dilated or not, always contains fluid mixed with bile. The symptoms are those of obstruction—persistent vomiting, obstinate constipation, and icterus.

Treatment.—When the occlusion is above the papilla, a posterior gastro-enterostomy by suture is the only operation indicated. When it is below the papilla, a duodenojejunostomy lateralis can readily be performed, as the duodenum is dilated to a great degree and presents a large serous surface to which a side-to-side attachment to the jejunum can be readily made. After passing the end of the jejunum through the mesocolon to the anterior surface of the duodenum, a lateral union can be established with a double row of sutures. The end of the jejunum can be closed by inversion. The same operation is applicable in *occlusions at the duodenojejunal junction*; they are less common in the jejunum itself than in the ileum.

Occlusions of the ileum are met with, as a rule, in the vicinity of the junc-

¹ Cordes, L.: "Congenital Occlusion of the Duodenum." *Archiv. Pædiat.*, 1901, xviii, 401.

² Herz, Hans: "Die Störungen des Verdauungs-Apparates," Berlin, 1898.

tion of the vitelline duct attachment (about 33 inches above the ileocecal valve).

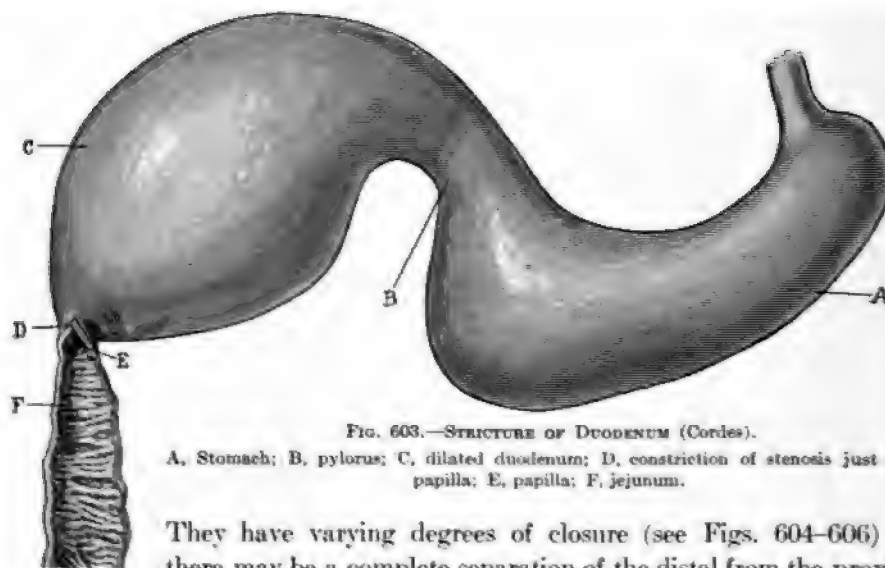


FIG. 603.—STRUCTURE OF DUODENUM (Cordes).

A. Stomach; B. pylorus; C. dilated duodenum; D. constriction of stenosis just above papilla; E. papilla; F. jejunum.

They have varying degrees of closure (see Figs. 604–606) and there may be a complete separation of the distal from the proximal end (Fig. 605). In “septate” ileum there is a diaphragm composed of mucosa and circular muscular fibers stretched across the lumen. The bowel outside may be perfectly normal, or show a slight



FIG. 604.—PERSISTENT VITELLO-INTESTINAL DUCT WITH VALVE (Bland-Sutton).

a. The patent vitello-intestinal duct; b. diaphragm; c. proximal end; d. distal end; e. perforation in diaphragm; f. patent vitello-intestinal duct.

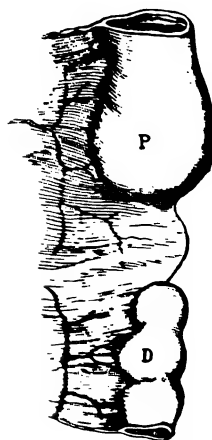


FIG. 605.—IMPERFORATE ILEUM after Bland-Sutton.

P. Proximal; D. distal end of ileum.

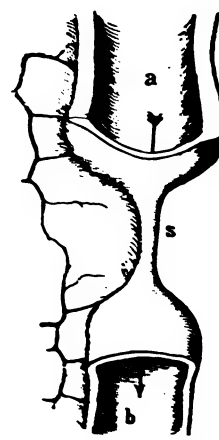


FIG. 606.—CONGENITAL CONSTRICTION OF ILEUM: SMALL TUBE-LIKE CONNECTION, PERMEABLE.

a. Proximal end; b. distal end; c. septum.

constriction corresponding to the location of the diaphragm. The latter may be imperforate or present an aperture of varying size. A man of sixty-two years who had never presented symptoms of obstruction and whose death was due to

myocarditis, was found to have a diaphragm 36 inches from the valve (Hudson¹). The bowel was slightly constricted externally, and very slightly dilated above the partition, normal below, showing that he suffered very little obstruction from the diaphragm. Two portions of bowel may be connected by a narrow pervious portion of very small caliber, often no larger than a crow-quill (Fig. 608). In such cases the proximal part is dilated more or less and the distal one is correspondingly contracted.

Finally, the bowel may end in a blind pouch, separated by a greater or lesser distance from the blind distal segment. Such a malformation is, of course, incompatible with life, and even in the lesser degrees of obstruction death usually ensues within the first weeks.

While surgical intervention affords the only chance of relief, the results obtained thus far have been most unsatisfactory on account of its tardy application.

Idiopathic dilatation of the colon (*megacolon*; *ectocolon*; *Hirschsprung's disease*) is a rare affection. Duval² was able to collect but forty-eight cases; Fenwick³

found that in 30,000 necropsies at the London Hospital from 1840 to 1900, there were only three cases of ectasia. Its causation is unknown. It is a disease of the first few days or months of life, though in five cases the symptoms first appeared at from fifteen to fifty years of age. It is much more common in males (thirty-six males, nine females); the character of the food seems to exert no influence whatever. The circumference of the bowel was 26½ inches in Banks's case and 23 inches in that of Walker.⁴ In the one of Formad⁵ which is so frequently quoted the colon contained 47 pounds of fecal matter. In thirteen cases (32.5 per cent.) the entire intestinal tract was dilated and in twenty-seven cases (67.5 per cent.) only a portion was ectasic. In the latter the sigmoid was involved

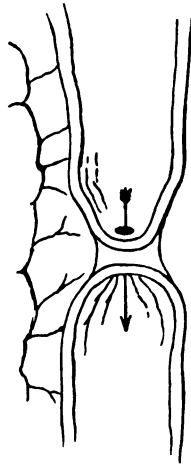


FIG. 608.—SHOWING SEPTATE ILEUM FROM CONGENITAL MALFORMATION (Bland-Sutton).

The two intestinal segments communicate by a small opening, as indicated by the arrow.

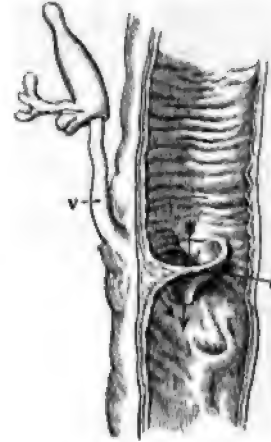


FIG. 607.—SEPTATE ILEUM; SMALL OPENING; PATENT VITELLINE DUCT AND NO CHANGE IN EXTERNAL APPEARANCE OF INTESTINE.

v, Vitelline duct; d, spiral diaphragm; arrow indicates opening.

¹ Hudson, L.: "On Congenital Abnormalities of the Lower Ileum." Trans. Path. Soc. London, 1889, xl, 98.

² Duval, P.: "De la dilatation dite idiopathique du gros intestin." Rev. de Chir., 1903, xxvii, 332.

³ Banks, W. M.: "Enormously Distended and Enlarged Sigmoid Flexure of the Colon." Dublin Jour. Med. Sci., 1846, i, 235.

⁴ Walker, J.: "Congenital Dilatation and Hypertrophy of the Colon Fatal at the Age of Eleven Years." Brit. Med. Jour., 1893, ii, 230.

⁵ Formad, H. F.: "A Case of Giant Growth of the Colon Causing Coprostasis," Univ. Med. Mag., 1892, iv, 625.

in twenty-one, the transverse colon in ten, and the descending in six. The rectum was affected in three cases and the small intestine in two only. The dilatation may occur in two segments some distance apart, separated by an intervening segment of normal lumen. The mesocolon is always thick and infiltrated, the appendices epiploicæ large, the arteries dilated, and the mesenteric nodes often hyperemic. The wall of the dilated portion is generally much thickened; in Mya's¹ case it measured 2.6 mm., instead of 1.5 mm., as normally. In one of the author's cases it measured $\frac{5}{16}$ inch. The mucosa is frequently ulcerated.

The *symptoms* are simple, and can be summed up as follows: intractable coprostasis and abdominal distention, with areas of percussion flatness. Other manifestations are sequelæ of these. As regards the former, the lapse of time between bowel movements is almost incredible, varying from five or six days to as many weeks. In Osler's² case a child of seven years had had but five or six spontaneous evacuations up to that age. Purgatives and enemas have no effect; even colonic flushing must be repeated several times to be efficacious. Flatus, however, escapes constantly. The abdominal distention is enormous; Osler's patient measured 32 inches in circumference at the navel, and Fitz's³ patient 28 $\frac{3}{4}$ inches. The distention is greater between the umbilicus and xiphoid than below the umbilicus.

The *prognosis* is grave; in forty-three cases, 69 per cent. died; eleven from obstruction (three acute, eight chronic). Treatment is not very encouraging; medical measures are of little use. Ten cases were operated on with a mortality of 24.8 per cent. (four colostomies, four colopexies, two colectomies). Intestinal puncture has been resorted to four times. Ileostomy or cecostomy in complete megacolon is the only operation that should be entertained. It can be performed in less than five minutes. In these cases the bowel should be united to the skin and a large opening made, as the bowel has lost its contractile power, and the latter can only be restored by months of physiologic drainage. The celluloid-linen (Pagenstecher) or the Turnbull and Wilson black Irish linen suture is preferable.

Meckel's diverticulum (*diverticulum ilei*), found in about 2 per cent. of all bodies (more frequent in the male), is the best example of true diverticulum. It is the remains of the omphalomesenteric duct of the fetus, which runs from the primitive intestine to the yolk-sac and disappears later on, leaving no trace. It may remain patulous throughout, or only at the intestinal end (Meckel's diverticulum) or at the umbilicus; it may remain patulous in the middle only; lastly, merely the vessels may be present.

The typical specimen of this anomaly consists of a blind tube the same diameter as the intestine, given off at right angles from the bowel, within a meter or so of the ileocecal valve. Occasionally it comes off from the mesenteric border, in which case it is usually provided with a mesentery of its own. It varies in length from a teat-

¹ Mya, G.: "Due Osservazioni di dilatazione ed ipertrofia congenita del colon," *Lo Sperimentale*, 1894, xlviii, 215.

² Osler, W.: "Notes on Tuberculosis in Children," *Arch. Pediat.*, 1893, x, 3.

³ Fitz, R. H.: "Persistent Omphalo-mesenteric Remains," *Amer. Jour. Med. Sci.*, 1884, lxxxviii, 30.

like projection of less than an inch to one of 8 or more inches. The end may be conical or T-shaped, and secondary pouches may arise from the diverticulum proper. Occasionally the end is filiform and floats among the intestinal coils.

The principal danger from the presence of this diverticulum is its tendency to give rise to intestinal obstruction, about 5 or 6 per cent. of all cases of the latter being due to it. If it is very long, the free end may become entangled with a loop of the bowel, forming a so-called "knot." The diverticulum in rare cases may invaginate into the bowel alone or drag the bowel with it, thus obstructing the latter. It may enter a hernial sac (Littre's hernia). The most frequent type of obstruction, however, is produced by fixation of the distal end of the diverticulum to the wall of the abdomen, the omentum, or the intestine, thus forming a loop, and in this loop a coil of intestine or omentum becomes strangulated; this is much more frequent when the end is thread-like. Of sixty-three cases of obstruction due to Meckel's diverticulum, the end was free in fifteen and attached in forty-eight (to mesentery, twenty-three; to umbilicus, fifteen; not detected, three; to small intestine, three; mesorectum, mesocolon, omentum, and periappendicular exudate, one each—Halstead¹).

Oderfeld² stated that the presence of other congenital deformities in patients with intestinal obstruction—for instance, harelip and the like—rendered it probable that the cause of the obstruction was a Meckel's diverticulum. This was first pointed out by Matthew Baillie and Meckel many years ago, and does not seem to have proved of much value in diagnosis. The symptoms otherwise are the same as in obstruction from other causes. As the diverticulum contains all the coats of the bowel and its histologic elements in its make-up, typhoid and other ulcers may be found in it; also foreign bodies.

When one of these diverticula is encountered during an operation on the abdomen for other causes, it should be excised, and the opening closed with a purse-string or, if large, with Lembert sutures. The treatment of the obstruction will be the same as that from other causes. The prognosis is serious; of thirty-two laparotomies collected by Bérard and Delore,³ death ensued in twenty-three.

Acquired diverticula (*false diverticula*, *hernies tunicaire*s), unlike the form just described, are not made up of all the coats of the bowel, the serosa and the mucosa escaping through a hole in the muscularis, generally on the side of the mesentery near the exit of the intestinal veins. They are most frequent in the large intestine and vary in number from a few up to four hundred (Hansemann).

These acquired diverticula are a common appanage of old age with its accompanying constipation, and have been considered pathologic curiosities. I have had eight cases of this character: in three of these the diverticula, located in the sigmoid, suppurated and gave rise to recurrent attacks of peritonitis, until removed by ex-

¹ Halstead, A. E.: "Intestinal Obstruction from Meckel's Diverticulum." *Ann. Surg.* 1902, xxxv, 471.

² Oderfeld: (quoted) in *London Lancet*, 1892, i, 273.

³ Bérard and Delore: "Occlusion intestinale produite par le Diverticule de Meckel." *Lyon Médical*, 1899, xc, 129.

section of that segment of the intestine. In three others drainage was instituted and foreign bodies removed. In two colostomy diverted the fecal current from the infected zone during the process of repair. Occasionally they cause fecal ulcers and even perforation and peritonitis, and are diagnosed appendicitis. In a case recently reported by Gordinier and Sampson¹ intestinal obstruction was caused by multiple acquired diverticula, producing obstruction of the small intestine.

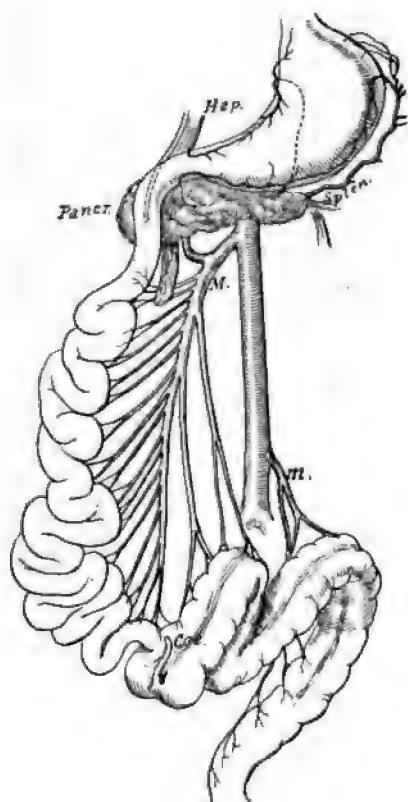


FIG. 609.—PERSISTENT COMMON MESENTERY, ALL OF THE INTESTINES FREE IN THE ABDOMEN, DUE TO FAILURE OF EMBRYONAL MESENTERIC REVOLUTION (after Farabeuf).

Coe, Cecum; M, superior mesenteric; m, inferior mesenteric artery; Pancr, pancreas; Spln, splenic artery; Hep, hepatic artery.

At an early period of fetal development the primitive large bowel crosses in front of the small bowel to assume the position found in adult life. Occasionally this torsion does not take place, and the large intestine remains on the left side of the abdomen.

If the mesentery supporting the small intestine, ascending and transverse colon does not become adherent to the posterior wall of the abdomen, we will have the condition known as persistent common mesentery. This is the state of affairs in fetal life when all these segments of the intestine float free in the abdomen (Fig. 609). A common mesentery may be combined with absence of torsion of the primitive bowel. In this case the small intestine is found to the right of the superior mesenteric artery and the large intestine to the left. The practical importance of these varieties lies in the fact that the cecum and appendix will be on the left side.

The same condition of affairs obtains in transposition of the viscera. Either the thoracic or the abdominal viscera alone may be transposed or both together.

When the mesocolon is over-developed—as it were—the transverse colon is thrown into loops or bends, which invariably point downward, and are usually angular, V- or

W-shaped, extending into the pelvis, where it may become adherent.

The hepatic and splenic flexures of the colon may be lacking, when the colon as a whole is shortened. In some instances, however, though these flexures are wanting, the colon retains its customary length or is even longer than usual.

In early fetal life the cecum is found outside the abdomen; from here it moves successively to the umbilicus, to the cardiac end of the stomach, to the right and down

¹ Gordinier, H. C., and Sampson, John A.: "Diverticulitis (not Meckel's) Causing Intestinal Obstruction," Jour. Am. Med. Assoc., May 26, 1906, xli, 1585.

into the iliac region. It may be arrested in its course and lie close under the liver, etc., or it may drop down into the pelvis.

The sigmoid loop in the fetus and young child is much larger, proportionately, than in the adult. This fetal condition may persist through life, predisposing to volvulus, and be a source of danger in this part of the bowel.

Lastly, reference must be made to slits or openings in the mesentery and omentum, a fertile source of intestinal strangulation. In the mesentery these are found surrounded by the terminal branches of the mesenteric artery, which map out an area absolutely free from blood-vessels, fat, or lymph-nodes. In some cases these holes are partly or wholly covered by a thin membrane; in others this membrane is cribriform and but little force would be required to entangle a knuckle of bowel in it; in still others there is a round or oval opening with smooth edges, an inch or so in diameter. In the omentum, loops and bands are found sometimes which appear to be relics of old attacks of peritonitis.

INJURIES TO INTESTINES DURING OPERATIONS.

The intestines must be carefully protected and pushed out of the operating field without too much manipulation. Noble¹ states that the viscera are handled much more by the surgeons in Europe than by the surgeons in this country, and that this is one of the reasons why they more frequently have post-operative complications. The Trendelenburg position, associated with protection of the intestines by a large laparotomy sponge of the 4-inch roller type, will prevent unnecessary and injurious handling of the intestines.

Separation of Intestinal Adhesions from Infected Cysts or Malignant Tumors.—This variety of adhesion, as well as that between the intestines themselves, is very often the cause of injury to the intestines. Sometimes this can be avoided, and again it may be impossible. In case of adhesions to malignant tumors, —for instance, carcinoma of the body of the uterus,—the growth is not only adherent to the wall of the intestine, but has infiltrated it. In such cases a safe separation cannot be made and should not be attempted, but exsection performed in its stead. In removing cysts of the ovary or of the broad ligament adherent to the intestines, injury may occur either in the form of perforation, transfixion, or simple abrasion, which latter will form an organic adhesion. Other injuries occur during curettage of the uterus in the hands of the inexperienced. The literature is full of cases of perforation of the uterus by a sharp curet with subsequent prolapse of the coils of intestine through the perforation.

I have recently operated on a case in which the uterus had been perforated during a curetment. The operator did not recognize the fact for three days, at which time he found a coil of bowel in the vagina. He at first supposed it was the funis, and exerting traction upon it detached 18 inches of the large intestine from its mesentery; recognizing it as intestine, he replaced it all within the vagina and transported the

¹ Noble, Charles P.: "The Present Status of Gynecology in Europe," *Amer. Med.*, Oct. 19, 1901, p. 601.

patient to the hospital; on admission the temperature was 105°. I made an immediate section and excised 18 inches of large intestine, made a side-to-side anastomosis with the button, uniting the colon with the very short stump of the rectum; the ends were closed by inversion with Pagenstecher linen Lembert sutures. The patient recovered.

Statistics in regard to injuries of the intestine during operation are few in number. Blau compiled a series covering cases in Chrobak's clinic from 1890 to 1900. In 2193 cases the abdominal viscera were injured forty-five times during operation, the uterus fifteen times, the bladder twenty-one times, and the intestine fourteen times. The intestines were injured seven times in laparotomies and seven times in vaginal operations. Of these fourteen cases, eleven ended fatally and three had intestinal fistulæ; two of the latter healed spontaneously.

As Blau points out, the intestines are injured most frequently when they are adherent to the adnexa. There may be primary perforation caused by the finger or instruments, or a secondary sloughing from the trauma inflicted during the separation of adhesions from the wall of the intestine and surrounding tissues.

The Trendelenburg position with its advantageous exposure of the field is materially lessening the number of similar occurrences; careful inspection adds much to the tactile sense in locating the lines of agglutination or adhesion. When the intestines and ovaries are matted together, too much care cannot be exercised in avoiding injury.

Many suggestions have been made from time to time as to the best means of preventing injuries to the intestines, and they will be referred to later on. Price¹ observes that in general better results are obtained in gynecologic operations when performed in the morning. Tait² stated that his mortality was but 3 per cent. when he operated in the morning and 8 per cent. in the afternoon.

ILEUS—INTESTINAL OBSTRUCTION.

The subject of intestinal obstruction has always been one of great interest, and will continue so until our methods and results in diagnosis are greatly advanced. Before entering into the details of the subject, let us make a mechanical estimate of the intestinal tract from the pylorus to the sphincter ani. It is a long muscular tube of varying size with anatomic constrictions in certain positions, either from (a) a special muscular development (sphincters), (b) from abrupt changes in the course of the canal (flexures), or (c) from gradual diminution in the size of the canal, as of the lower end of the ileum. This canal has, besides its physiologic functions of secreting, absorbing, and excreting, the power of propelling its contents by its own muscular contraction. It can readily be seen that a fecal stasis could be produced:

First, by the absence of muscular contraction—paralysis. This paralysis may

¹ Price, Joseph: "Analysis of Common Causes of Death following Pelvic and Abdominal Operations," *Amer. Jour. of Obstet.*, 1903, xlviii, 628.

² Tait, L.: "Dis. Women and Abd. Surgery," vol. i, 1889.

be due to a spinal lesion, an interruption in the afferent nerve, or there may be a local paralysis, as from infection at the terminal filaments.

Second, from tonic contraction, as from mineral poisoning (lead), and from certain ptomain poisons, as tyrotoxinon.

Third, it may result from mechanical causes, as constriction in the lumen, flexion at a sharp angle, occlusion by a foreign body, as a gall-stone or neoplasm; compression from without, twisting on itself—volvulus.

With this short consideration of the mechanics of obstruction we will take up the subject of ileus in general clinically. By the term *ileus* is meant, not a definite pathologic entity, but a syndrome of symptoms produced by very different causes. The symptoms of ileus are abdominal pain, inability to produce bowel movements (coprostasis), nausea or vomiting, and meteorismus (tympanites). These symptoms may be produced by adynamic, dynamic, and mechanical causes.

The most common symptom is the coprostasis, and as this can result from such varied causes, it seems to me that the best method of diagnosis will be by exclusion, which can only be effected by keeping all of the conditions and etiologic factors clearly in view. While mechanical ileus is the only true type of intestinal obstruction, coprostasis, the essential symptomatic factor, is produced by all of the etiologic factors mentioned in the following table. It would be more acceptable probably, from a purely scientific standpoint, to separate the dynamic and the adynamic varieties from the mechanical, but a bedside experience with extensive material has convinced us that the following classification is the most practical from a clinical standpoint and is the most easily applied to the individual case. We therefore adhere to the term ileus as indicative of fecal stasis and symptoms associated with it, and include under it mechanical obstruction of the intestine.

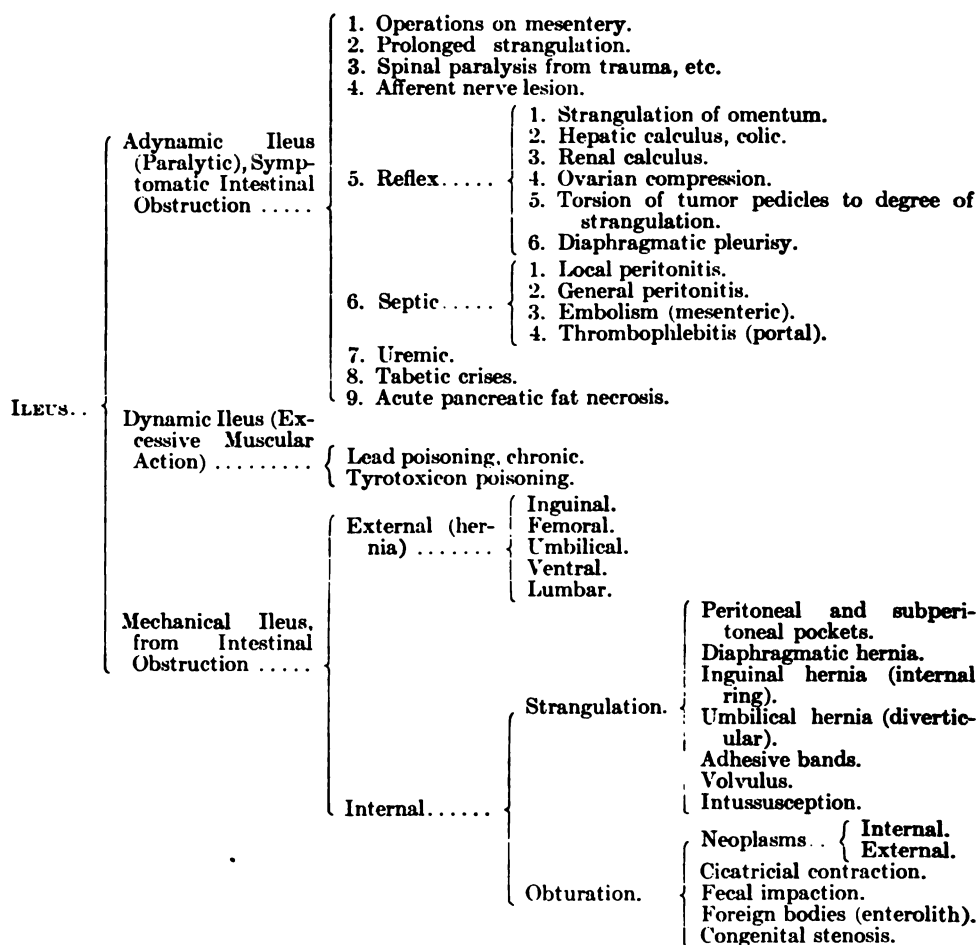
PATHOLOGY.

The scheme on page 392 is a synopsis of the varied pathologic conditions which produce the symptomatic syndrome of ileus.

Adynamic ileus signifies without power, or paralytic ileus. It presents all of the symptoms of a coprostasis from mechanical obstruction, while in reality it is one from deficient muscular contraction. It constitutes 70 per cent. of all cases of ileus; it is always the result of paralysis of a larger or smaller portion of the intestine from the following causes:

1. Paralysis from extensive operations on the mesentery, disturbing its circulation and motor nerve-supply.
2. Paralysis of a loop returned after prolonged strangulation, particularly from femoral hernia.
3. Injuries to the spinal cord, as fractures, bullet wounds, and punctures.
4. Injury to the afferent nerve, mediastinal bullet or stab wounds.
5. Reflex paralysis, as that produced by the transit of gall-stones in the ducts, renal calculi, strangulated omentum, compression of an ovary, or torsion of a tumor pedicle to a degree of strangulation.

SCHEME.



6. Septic paralysis from peritonitis, cholecystitis, salpingitis, embolism of mesenteric artery, appendicitis, etc.

About 90 per cent. of the cases of ileus involve the small and 10 per cent. the large intestine; about 70 per cent. occur in males.

In the first class where *extensive operations have been performed on the mesentery* for the removal of tumors, the repair of lacerations, etc., there is always danger of paralysis and gangrene of the coil as a result. I have shown by experiments that the parallel artery, which runs in the mesentery close to the bowel wall, must be given the greatest consideration in operating on the bowel and mesentery. When it is injured, as by a bullet, or in an operation for the removal of fibromata, lipomata, etc., resection should be made of that portion of the intestine from which this blood-supply has been cut off.

Ileus following the return of a bowel that has been strangulated for a considerable time, and particularly the severe strangulation of femoral hernia, is due to thrombo-

sis of the veins, or a local paresis or ischemia from the occlusion of the parallel artery, and not infrequently causes a fatal termination in cases where appearances promised



FIG. 610.—ADYNAMIC ILEUS: THROMBOSIS OF MESENTERIC ARTERY (Bloodgood).
a, Normal area; b, thrombosed area.

a restoration of circulation and function of the bowel when returned. This form of ileus must not be confounded, however, with that following reduction of hernia *en*

bloc, which will be considered later. Necrosis with perforation or encapsulation may result.

A rare cause of ileus is embolism of the mesenteric artery, producing an ischemia, paralysis, and gangrene.

Hemorrhage, pathologic lesions, or injuries of the spinal cord produce a paralysis of the intestine, followed by great meteorismus, which may continue for several days after the injury. It is one of the most unpleasant complications following fractures of the spine. The abdomen becomes enormously distended, interferes greatly with respiration, and may even produce prolapsus recti.

Injury to the afferent nerve-supply, as a blow upon the epigastrium, may produce a paralysis and all the manifestations of obstruction; a bullet wound in the mediastinum may have the same effect, as is illustrated in the following case, which occurred during my service at Cook County Hospital in the spring of 1890:

A police officer was pursuing a burglar upstairs, when the latter turned and fired downward. The bullet passed into the mediastinum at the right sternoclavicular junction. There was no evidence of injury to the lung, large blood-vessels, nor stomach, but the patient gradually developed the symptoms of ileus; pain in the abdomen, not severe; slight tenderness, persistent vomiting; enormous distention of the abdomen; flatness of the most dependent portion of the abdomen upon change of position; complete absence of peristalsis; inability to induce bowel movement. These symptoms continued for seven days; patient's pulse was then 140; temperature, 99°; respiration, 46; facial expression bad, and death seemed imminent. Diagnosis, perforative peritonitis, through the diaphragm. Laparotomy: The intestines were found enormously distended, but not congested in the least; no inflammation at any place in the peritoneum; a small quantity of transuded serous fluid was present in the most dependent portion of the cavity. The fluid contents of the bowel gravitated with alteration of position and explained the cause of the change in the location of dullness noticed before operation, viz., that dullness was present always in the dependent portion of the abdomen, but the operation showed it was not due to free fluid in the cavity, but to fluid that gravitated to the dependent portion of the intestine on account of the complete paralysis. The stimulation of the operation produced an active peristalsis, which was soon followed by the passage of gas and feces; vomiting ceased, pulse improved, and the patient made a rapid and uneventful convalescence. This is a typical case of ileus from afferent nerve paralysis.

Reflex ileus may be produced by: (a) strangulation of omentum; (b) gall-stone obstruction in the cystic or common duct; (c) impaction of renal calculus in ureter; (d) compression of an ovary; (e) diaphragmatic pleuritis; (f) torsion of tumor pedicle to degree of strangulation (Fig. 612).

In strangulated omentum the symptoms of ileus are very pronounced and continue for a considerable time. The differential diagnosis between it and mechanical obstruction of the intestine is based on the presence of borborygmus in the former and its absence in the latter.

Another cause of reflex ileus which has been recently emphasized is torsion of the omentum (Plate V).

PLATE V.



TORSION OF THE OMENTUM (Scudler).



This was first discovered by Oberst¹ of Volkmann's clinic in 1882, and some forty-four have been recorded in the intervening period. The condition is much more frequent in men (75 per cent.), the ages ranging from nineteen to seventy-nine. Hernia coexisted in nearly all cases. The femoral variety has not been met with so far, but of nineteen cases a right inguinal hernia was present in thirteen. As a rule, the hernias were of long standing, some congenital, and in others from eight to thirty years. The hernial mass was generally reducible, at least up to the onset of symptoms; in one, however, it had been irreducible for twenty years. The size of the hernial protrusion seemed to have been of no significance. Oberst believed the cause in his case was violent taxis; this seemed to hold good also in Hochenegg's² case; in four it was thought that violent and sudden efforts had brought on the condition. In the rest the exciting cause could not be determined.



FIG. 611.—SALPINGITIS WITH TWISTED PEDICLE CAUSING SYMPTOMS OF ILEUS (Seguin).

As regards the *pathologic anatomy*, a hernial sac was always found on the same side as the omental tumor. In four the sac was empty, in thirteen it contained the lower part of the omentum, and in one the middle part; the intestine was never found in the sac. The part of the omentum within the sac, while never strangulated, had generally undergone the changes usually met with in epiplocele incarcerations. Adhesions, for example, were especially noticeable, varying from single bands up to nearly total obliteration.

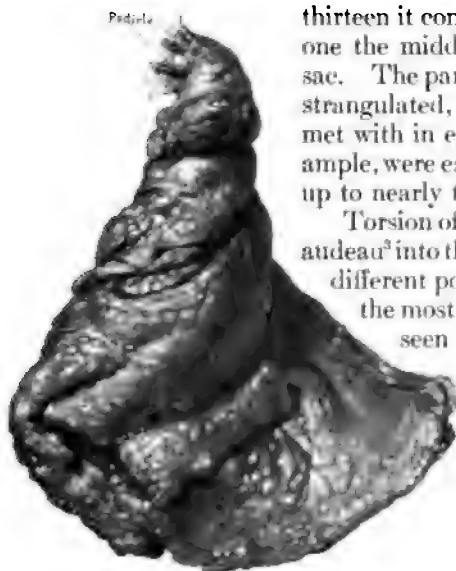


FIG. 612.—TORSION OF ACCESSORY OMENTUM. ONE-HALF NATURAL SIZE (Cullen's case).

Torsion of the omentum is divided by Vignard and Giraudeau³ into three varieties: Torsion at a single point, at two different points, and complex torsion. The first is by far the most common (thirteen cases), the second has been seen four times, and complex torsion three times.

The number of turns varies from one to several; six appears to be the maximum.

¹ Oberst, M.: "Zur Kasuistik des Bruchschnittes nebst einigen Bemerkungen Über Netzleklammungen." *Cent. f. Chir.*, 1882, ix, 441.

² Hochenegg, Julius: "Ein Fall von Ileus, bedingt durch eine in ihrem Stiele torquirte Ovarialeyste." *Wien. klin. Woch.*, 1888, i, Nr. 2, 29.

³ Vignard et Giraudeau: "Torsion intra-abdominale du grand épiploon," *Arch. Provinc. de Chir.*, 1903, xii, 206.

The *diagnosis* is very difficult, and in none of the cases was it made previous to operation. In five it was mistaken for appendicitis. The symptoms are not especially striking and present nothing pathognomonic. Pain is the most constant; it is abrupt, acute, and agonizing, and so marked the patients are forced to bed. It is generally continuous, though in a few it was intermittent, and in one-half it was most intense at the apex of the hernia. Vomiting was present in one-third of the cases; it was sometimes greenish, but fecal in none. There was no temperature elevation, which should have differentiated it from appendicitis and all of the septic types of ileus. Constipation was frequent; complete coprostasis was less common, and in a few, the occlusion not being complete, there was passage of flatus. On examination the abdomen was distended, sensitive, and occasionally presented a small amount of ascites. Attention is soon called to the swelling in the groin, and many observers have noted the presence of a firm mass filling the inguinal canal, acting as the pedicle of the tumor.

In the collected cases recovery was the rule. One patient died who was operated on while moribund; one from delirium tremens and two from bronchopneumonia.

Prompt operation is, of course, the only *treatment*, and if we cut down on an apparently strangulated hernia and find only a strand of omentum in the inguinal canal, the portion of the omentum still in the abdomen should be carefully examined to be sure it is not twisted.

In obstructions to the cystic or common duct the symptoms of ileus are also pronounced and continuous.

Ileus from renal calculus is of shorter duration than the varieties above mentioned.

Occasionally an ovary is compressed between the bony wall of the pelvis and a fibroid or other tumor, producing the symptoms of ileus, which continue with greater or lesser severity until the ovary is released. Torsion of tumor pedicles may occasion symptoms resembling ileus.

Diaphragmatic pleurisy or the pleurisy accompanying lobar pneumonia is frequently diagnostic as intestinal obstruction.

Septic or infection ileus occurs from: (a) peritonitis general; (b) peritonitis local. The infection of the peritoneum may occur from a perforation, through impaired resistance of the wall, from an ulcer in the appendix or intestine, through a diseased tube or gall-bladder, or from a suppuration contiguous to it. As a result of this infection, an acute, rapidly destructive type may develop where the symptoms of obstruction are pronounced at the onset and continue until a few hours before death, when relaxation takes place, and there are frequent fluid bowel discharges. This is characteristic of peritonitis and does not occur in mechanical obstruction. The infiltration of the intestinal wall produces a paralysis of peristalsis, and the more virulent the poison, the more complete and lasting the paralysis. In the subacute and circumscribed inflammations of the peritoneum the symptoms of ileus are less pronounced and pass away in about forty-eight hours after the onset of the attack.

Uremic ileus is one of the varied forms of uremic manifestations; in the intestinal variety we have symptoms very closely resembling those of mechanical intestinal obstruction. The physical signs of mechanical obstruction, as increased peristalsis, tympanites, and circumscribed areas of dullness, are absent, while the vomiting and

coprostasis are persistent. No other uremic symptoms may be present to suggest the diagnosis, but an examination of the urine demonstrates organic disease of the kidneys. It must be remembered that intestinal obstruction can occur in a uremic patient and, on the other hand, that a small percentage of albumin is often present in mechanical ileus.

Tabetic crises not infrequently resemble periodic intestinal obstruction of the mechanical type. The pain, nausea and vomiting, abdominal distention, and coprostasis are present and often continue for hours and days. These cases have been operated upon innumerable times for mechanical obstruction, as also for gallstones, renal calculi, etc., all of which they so closely mimic. The diagnosis of tabes can usually be made by the Argyll-Robertson pupil, the Romberg symptom and the absence of tendon reflex, etc. It must be borne in mind, however, that true intestinal obstruction can occur in a tabetic, and a most painstaking diagnosis must be made to avoid error on either side.

Acute Pancreatic Fat Necrosis; Acute Hemorrhagic Pancreatitis.—Both of these have the characteristic symptoms of ileus.

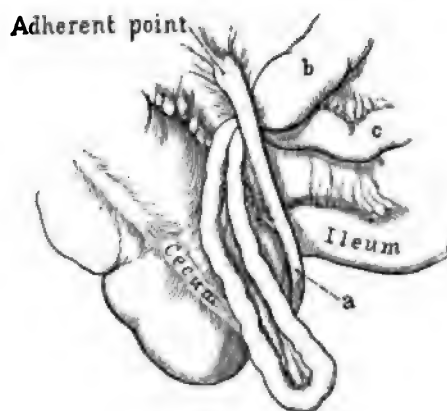


FIG. 614.—OBSTRUCTION OF INTESTINE BY ADHERENT APPENDIX (after Weir).
a, Appendix; b, distal end; c, proximal end.

The primary pain is more intense and the collapse more severe than is usually found in mechanical ileus, not even excepting extensive volvulus or severe strangulations of the upper jejunum or ileum. The pressure pain is greater and the muscular resistance in the upper abdomen much more pronounced than in the mechanical type of ileus, with an absence of temperature elevation in the early hours of the lesion which is so conspicuous in the epigastric types of septic ileus. An exploratory incision is the only means of making the differential diagnosis. The swollen pancreas and the gray, yellow, or blood-colored plaques on the peritoneal surfaces, in the mesenteric and fatty tissues, are typical and diagnostic of the pancreatic lesion. Careful tamponing with incision is the treatment of these conditions when they are discovered in the exploratory incision for ileus. Details are given under surgery of the pancreas.

Dynamic or Hyperdynamic Ileus.—This constitutes 2 per cent. of the cases

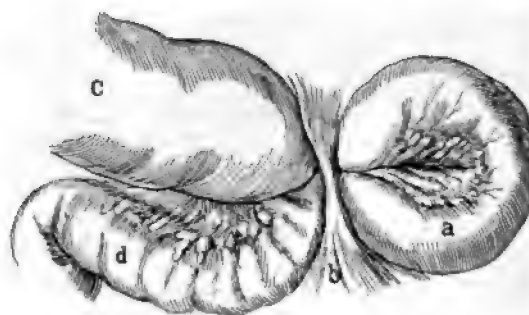


FIG. 613.—LOOP OF INTESTINE OBSTRUCTED BY FIBROUS BAND.
a, Strangulated loop; b, band of adhesion; c, proximal end; d, distal end.

The primary pain is more intense and the collapse more severe than is usually found in mechanical ileus, not even excepting extensive volvulus or severe strangulations of the upper jejunum or ileum. The pressure pain is greater and the muscular resistance in the upper abdomen much more pronounced than in the mechanical type of ileus, with an absence of temperature elevation in the early hours of the lesion which is so conspicuous in the epigastric types of septic ileus. An exploratory incision is the only means of making the differential diagnosis. The swollen pancreas and the gray, yellow, or blood-

of ileus and is produced by a tonic contraction of the circular muscular fibers of the bowel. This contraction may continue for days. It may be caused by poisoning with lead, tyrotoxicon from milk, cheese, etc. Borborygmus is feeble or absent. In all of the cases of adynamic and dynamic ileus no opera-

tive procedure for the ileus *per se* is indicated.

Ileus from tonic contraction of the circular muscular fibers of the intestinal wall has a mechanical obstruction with all of its concomitant symptoms, lasting many days. The writer sectioned a lead colic patient after seven days of coprostasis; found a coil of intestine 11 inches long which was hard and rope-like; it rapidly relaxed after a few minutes' exposure to air and hot applications.

Mechanical Ileus or Mechanical Obstruction.—This represents 28 per cent. of all cases of ileus. It is subdivided into: (1) Strangulation of intestine, internal (Fig. 615) and external (her-



FIG. 615.—SECTION OF SIGMOID AND DESCENDING COLON RESECTED FOR FECAL IMPACTION.

Measurement 11 inches in circumference, 17 inches in length. From child five years old.

nia); (2) torsion or volvulus; (3) auto-invagination, intussusception; (4) obturation, internal (neoplasms) (enterolith) and external (incarcerated hernia) tumor compression.

The internal types of strangulation are very numerous and most difficult of recognition. They are produced by fibrous bands, adherent appendix, adherent intestinal loops, adherent Meckel's diverticulum, slits in the mesentery, foramen of Winslow, congenital subperitoneal pockets in the neighborhood of the inguinal tract and femoral opening, retroperitoneal fossæ, as the duodenojejunal, external

sigmoid, and retrocecal. These subperitoneal pockets may be very large, and even contain the entire intestinal tract in a retroperitoneal connective-tissue pouch; a greater or lesser portion of straight intestine may be in the free peritoneal cavity, while the major portion may be behind or external to the peritoneum. When the intestine is strangulated in one of the pockets, particularly at the duodenojejunal fossa or in the retrocecal cavity, the fixed end of the intestine may be mistaken for the normal intestinal attachment and the strangulation overlooked. The constricting band should be freed and the intestine, if gangrenous, withdrawn and excised. In the congenital retroperitoneal displacements no effort should be made to restore the intestine to the peritoneal cavity. This anomaly occurs usually as a great surprise to the operator, and unless he is cautious his lack of information of the embryologic relationship may lead to danger by his procedure.

1. By *strangulated hernia* we mean that not only is the intestinal tract impermeable to its contents, but that the circulation is impeded or suppressed, the nutrition of the coil is shut off, and its necrosis is imminent. The direct mesenteric vessels are the first to yield to the pressure, but the parallel vessel keeps up the blood-supply for a long time, as it is so thoroughly protected against pressure by its position and its encapsulation with fat.

2. *Volvulus or torsion* of the intestine is usually secondary to some intestinal adhesion or malformation, except when it involves the sigmoid. When the latter with the colon is included in the volvulus, the distention is often enormous, forming a distinct tumor.

3. *Invagination* holds a middle place between strangulation and obturation, as well for the severity of its symptoms as the tendency to local necrosis and danger to the life of the patient.

4. In *obturation ileus* the symptoms come on more slowly, the local destruction is more gradual, and the danger to life is more distant, depending upon the degree of obstruction and the cause, whether it be simple contraction of the lumen of the bowel, a gradual compression of its caliber by an occlusion from within, an obstruction by a foreign body, as a gall-stone, an intestinal fibroma or polypus, a gradual filling and compression from carcinoma or sharp bending of the canal. Coprostasis of many days' duration in these cases does not terminate fatally.

Neoplasms are not infrequently causes of intestinal obstruction. They may be divided into those involving the intestinal wall and those external to and com-

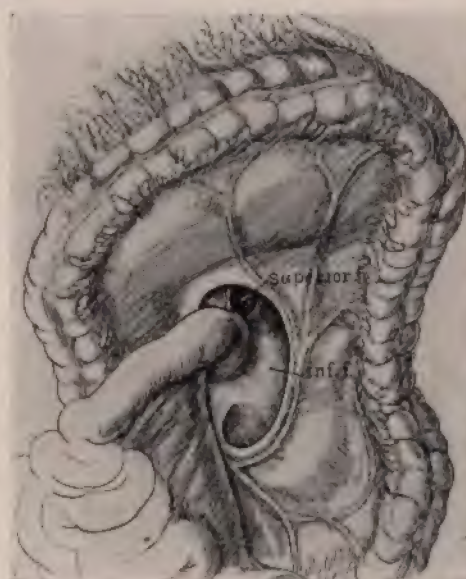


FIG. 616.—PARADUODENAL FORSSA OR FORSSA OF LANDZIRT (after Moynihan).

pressing the intestine; each, again, may be subdivided into innocent and malignant. The operative treatment is mentioned elsewhere. The most common type of non-malignant obstruction is from fibromata or polypi. In the malignant obstruction carcinoma is the most common; it, however, rarely occurs in the small intestine. Sarcoma does not often produce a diminution of the lumen of the intestine; on the contrary, the lumen in the great majority of cases is enlarged.

Cicatricial contraction takes place most frequently at the site of an ancient ulcer.

This, however, in the small intestine is not at all necessary. We have annular contractions from cicatricial deposits in the fibrous coat of the bowel in which the mucosa shows no evidence of ever having been involved, resembling septate ileum. The etiology of these contractions is not known. The patients often suffer for months and years from periodic obliterative ileus before they come to the operating table. The treatment is excision with end-to-end or side-to-side anastomosis; in the small intestine preferably the former.

Foreign Bodies—Enteroliths; Choleliths.—Enteroliths are usually formed by undigested particles of food, masses of hair, etc. These usually form in the stomach and progress

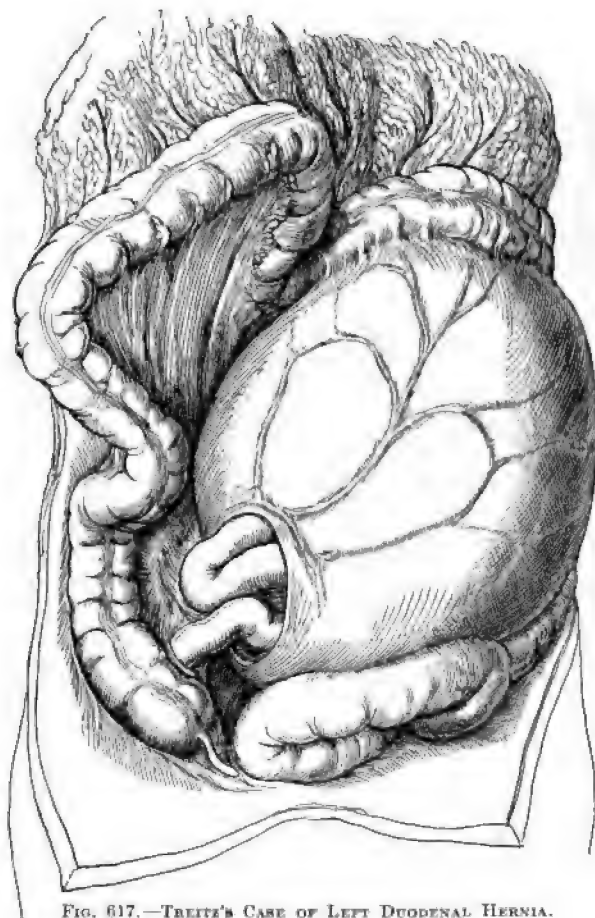


FIG. 817.—TREITZ'S CASE OF LEFT DUODENAL HERNIA.

through the intestine, sometimes slowly and many times occupy years in transit. I recall one case where the patient suffered from periodic obstructive symptoms for sixteen years. The history showed that the primary attack shortly followed the swallowing of a bolus of plum pudding. On removing the mass from the intestines by enterotomy in an acute attack it was clearly demonstrated that it was made up of plum pudding, having been in transit in the intestine for sixteen years. It had developed many diverticula in the small intestine, and it was only when it was dislodged from one of these pockets that it gave acute symptoms. In

animals, mainly in dogs, hair enteroliths are found. There is no pain during the time these masses are resting in the diverticula, but when they move forward and dilate a new area, then the typical obstructive symptoms are produced. Foreign bodies are best removed by longitudinal incision in the convex portion of the bowel diametrically opposite the mesenteric attachment. The wound should be closed with a Czerny-Lembert suture.

Fecal impaction occurs in the large intestine only. It is common in the aged, but is not infrequently seen in middle age. In children it occurs in association with stenosis of the rectum or sigmoid, and occasionally fecal accumulations take place in



FIG. 618.—RETROPERITONEAL HERNIA.

The large intestine is pulled up. The small intestine is seen to be enclosed in a sac behind the parietal peritoneum. It is entirely within this sac save the terminal portion of the ileum which passes out over the stick. The edges of the paraduodenal fossa into which the intestine herniated are well shown.

the balloon enlargements from other pathologic conditions. Recently I resected 17 inches of the sigmoid and descending colon for impaction in a child five years of age. A year preceding the fecal accumulation she had an enormous ballooning of the sigmoid and descending colon from an adhesive band. This was freed by operation and the intestine contracted and remained so for a year. The history of fecal retention extended over a period of sixty days. At the time of operation the fecal mass was 11 inches in circumference and 17 inches in length.

Treatment.—Where the feces cannot be molded and removed through an anal dilatation they must be treated by section. If when the abdomen is opened the fecal mass is not too firm to permit of molding, it may be subdivided into small

round masses and pushed on through the intestine and out through the dilated anus. If it is situated too high up for this treatment to be practicable, a longitudinal enterotomy may be performed and the fecal mass turned out, the intestines closed with a Czerny-Lembert suture, and three or four additional rows of longitudinal Lembert sutures inserted, enfolding or scrolling the colon so as to lessen the likelihood of subsequent dilatations. If the ampulla is large, and particularly in young people, excision should be the operation of election with end-to-side or side-to-side approximation either by suture or the oblong button.

DIAGNOSIS.

Can we differentiate with any degree of certainty at the bedside between the various forms of ileus or between the various groups? This can safely be answered in the affirmative. When we consider that the syndrome or symptoms included in the term ileus occurs under so many distinct and varied pathologic conditions, it is easily understood why the results in practice differ; why the statistics of various men differ; why one class of doctors finds that 100 per cent. of the cases of ileus not operated die, and another class finds that 34 per cent. of them recover without operation. The reason for these apparent discrepancies is that different pathologic conditions are included under the name of ileus by the various observers.

HISTORY, ETIOLOGY, AND CLINICAL COURSE.

We will now endeavor to draw attention to the history, the etiology, and the clinical course of ileus as a guide to the treatment.

The history will assist us greatly, indeed, if not assure us of a diagnosis of intestinal paralysis resultant from operations on the mesentery, the return of a long strangulated hernia, injuries to the spinal cord, injuries to the afferent nerve-supply, and aids us somewhat in making a diagnosis of thrombosis and embolism of the mesenteric vessels and hernial strangulation. In the reflex paralysis, gall-stone colic with or without jaundice, or renal colic, a history of previous attacks aids in the diagnosis. The history is of less value in the inflammatory and the internal mechanical varieties; here the clinical course, symptoms, and signs will have to be relied upon.

The abdominal pain is recognized as a manifestation of irritation of the terminal nerve filaments of the peritoneum and intestinal wall, and will vary in intensity, continuity, and locality, depending upon the lesion present. Pain in mechanical and in reflex ileus from hepatic and renal calculus is always intermittent or wavy. Inability to produce bowel movement has already been explained and may be due to many causes, which will be given in detail in analyzing the different groups.

Fecal vomiting, when it occurs, always comes from a mechanical obstruction of the intestines. In the literature on the subject we find records of cases where formed feces were vomited. The accurateness of this observation I question. It is of rare occurrence to find vomitus which has the distinct odor of feces. It is an odor

different from the fecal, that of decomposition of intestinal contents. I have seen but two cases in an extensive experience in which a distinct fecal odor was present, and both were obstructions of the descending colon. Formed feces could come only from the large intestines, and I believe this has never occurred. The material which has been considered formed feces is mostly caseous, curdled milk, which has received its color and odor in the stomach from the regurgitated contents of the intestine. One should never wait for fecal emesis to make a diagnosis. The vomiting in mechanical intestinal obstruction *increases* in frequency with *increase* of time. Reflex vomiting *diminishes* with time. It requires as much knowledge, experience, and judgment to determine when not to operate as when to operate in ileus cases, as we have learned that 72 per cent. of all cases of ileus do not require operations for mechanical obstruction.

Meteorismus occurs in three places in the intestine: Above the seat of obstruction, in the strangulated loop, or in the paralyzed portion—the latter may be a coil or the entire intestinal tract. The contents of the distended intestine differ materially in the three different conditions. In mechanical occlusion on the proximal side close to the obstruction the intestine is usually full of liquid feces, principally transudation from the mucosa. With strangulation or occlusion of a coil it is distended about one-third with gas and two-thirds with liquid. The source of this fluid and gas I have demonstrated conclusively to be transudation and decomposition. This gives circumscribed areas of resonance and flatness on percussion.

Of the constitutional reactions, one deserving particular attention is the excretion in the urine of phenol and indican. These are the products of absorption of decomposed proteids from the intestinal tract. The indican is present in occlusions of the ileum and absent in obstructions of the large intestine.

Next in importance is a careful physical examination. Inspection, palpation, percussion, and auscultation should be practised systematically in every case of intestinal obstruction, as each has a very positive value in assisting us in making a diagnosis. By these we recognize the changes in form, in resistance, position, and movement of the intestinal coils.

SYMPTOMS.

Adynamic Ileus.—We will now consider the symptoms in particular forms of ileus.

Ileus from *paralysis following extensive operations* on the mesentery can be at once recognized by the operator and managed better from a prophylactic standpoint than from any other; that is, by a resection of the portion of the bowel where the circulation has been compromised at the time of the primary operation.

Ileus due to *paralysis of long-standing strangulation*. This I will consider when treating of hernia.

Ileus following *embolism of the mesenteric artery* has no pathognomonic train of symptoms or signs, but the history of other foci of sepsis aids very much in leading to a diagnosis of this rare condition.

Ileus the result of *paralysis of the intestine from injuries to the spinal cord* is readily recognized.

Injuries to the afferent nerve-supply from direct contusion or from bullet or stab wounds produce ileus where the abdomen has not been involved by the traumatism directly; this variety is usually accompanied by retention of urine, while in perforation of the viscera this symptom is not present.

Reflex ileus from renal calculus is recognized by the spasmodic character of the pain, its location in the loin and course of the ureter, its intensity, its reflex on the bladder and testicle, its duration, the position of tenderness, the progressive change of its location, and the information obtained from an examination of the urine. The same symptoms are of value in recognizing periodic hydronephrosis.

In hepatic calculus there is greater difficulty in making a differential diagnosis. First, when the gall-stone is still within the gall-bladder the pain gradually increases and reaches its greatest intensity about an hour after the onset. It continues for a few hours and subsides to return again in a short time. There is no borborygmus, no elevation of temperature, but there is pronounced local hypersensitiveness. When the common duct is obstructed the onset is more sudden, the pain more intense, always accompanied by bile in the urine, often jaundice, depending upon the duration of the obstruction, and other symptoms well recognized and familiar to all.

Another variety of reflex ileus is that produced by compression of an ovary by fibroids. It may be recognized by the history of the case and the location of the pain, which can be lessened or increased by certain movements of the fibroid, and frequently relieved by changing the fibroid from its impacted position. There is a class of cases in which the manifestations of ileus are very pronounced, that due to the mass ligation of pedicles. Since the practice of ligating pedicles *en masse* has ceased, surgeons are having less vomiting after operations, and fewer cases of post-operative paralytic ileus. The practice of ligating a large pedicle *en masse*, formerly in vogue, was the cause of many of the reflex symptoms following operations on the lower abdomen. If a large pedicle must be ligated, it should first be crushed with the angiotribe or clamp so as to necrotize the tissue at the point of ligation; then it will not give rise to reflexes.

Diaphragmatic pleurisy or pleuro-lobar pneumonia may be confounded with intestinal obstruction. Error is more common in children. The surgeon is called to see children in whom there is enormous distention of the abdomen with pain, vomiting, coprostasis. There is absence of peristalsis, and the same intestinal inactivity when the stethoscope is placed on the abdomen that there is in the other types of paralytic ileus. But there is always present in this class of cases what we never find in primary mechanical obstruction of the intestine—elevation of temperature.

Gastric tetany, with or without hemorrhage from the mucosa, is another condition of reflex or of paralytic ileus that is mistaken for mechanical obstruction. The enormous distention of the stomach to two, three, or four, or even five quarts capacity

immediately after operation leads to the belief that the patient has obstruction of the bowel below, while the entire condition is due to over-distention of the stomach, notwithstanding the very frequent vomiting of small quantities; he can be relieved of the vomiting, distention, and distress, only by passing a stomach-tube and withdrawing or liberating the enormous quantity of fluid which has accumulated in the stomach. This condition if not recognized leads to a fatal termination. The same clinical syndrome is occasionally present in pyloric stenosis with gastrectasia. The stomach becomes so dilated that it may reach even to the symphysis.

Peritoneal trauma is another—and a very important—cause of paralytic ileus. The surgeon who produces much peritoneal trauma is certain to have excessive mortality. The peritoneum is a sensitive organ, and every trauma committed in the operation tends to produce distention and paralysis of the intestine after its completion.

Infection Ileus.—Ileus from peritonitis occurs under two conditions, namely, a circumscribed local inflammation and a general peritoneal infection. In ileus from circumscribed inflammation we have the symptoms so commonly observed in circumscribed suppuration at the seat of the appendix. The pain occurs suddenly and may be either local, referred, or general, but is most severe at one point. The nausea and vomiting are of short duration, usually not more than one half hour, and within six or eight hours there is elevation of temperature to 100° or more, and not infrequently a chill. The information obtained from the pulse is of little significance. Marked resistance of the abdominal muscles and tenderness are present over the seat of inflammation. The tympanites is limited. The apparent induration is circumscribed. The deep percussion note is resonant in the early stage; the piano percussion note is flat, and this method of percussion I consider the most important in eliciting dullness when small inflammatory exudates are present. Auscultation shows an absence of peristalsis over the region of inflammation, with peristalsis moderately active over the remaining portion of the abdomen. In making a careful examination with a stethoscope and an indelible pencil it is interesting to note how accurately the area of adhesion and exudation can be outlined by the absence of peristalsis and subsequently proved in the operation. The symptoms of ileus pass off with these local inflammations in from twenty-four to forty-eight hours, when a free bowel movement can be produced by the use of cathartics. These same symptoms, only less pronounced, occur with circumscribed adhesive peritonitis from cholecystitis and tubal infection, and in each case can be differentiated by its location and history.

Note what a great contrast this forms to the ileus of general peritonitis. In this variety the pain is intense and extends all over the abdomen; the nausea and vomiting are persistent for days; the temperature elevated to above 100° except in the presence of collapse; the pulse frequent, small, and thready; the skin cold; the countenance depressed; anxious expression; enormous and uniform meteorismus; absence of abdominal respiratory movements; knees flexed. On palpation resistance is greatest over seat of origin; muscles are firmly contracted; deep percussion note uniformly resonant; piano percussion note dull over area of adhesion

and exudation. There is complete absence of peristalsis; a uniform splashing sound with each respiration, caused by motion of fluid in bowel, must not be mistaken for it. In such a condition the sound is uniform with every respiration; in peristalsis it varies constantly. *It is impossible to induce a bowel movement; the coprostasis is as complete as if the intestines were ligated, and remains so until a few hours before death, when relaxation takes place.* To the inexperienced the latter is considered an indication of relief of the "obstruction," but it is really a sign of impending dissolution. The cause of the ileus in these cases is a peripheral paralysis. In septic ileus there is always a primary elevation of temperature; in mechanical ileus there is never a primary elevation of temperature; in both there may be a hyperleukocytosis or a hypoleukocytic reaction (leukopenia).

The symptoms of pain, nausea, and vomiting may occur just the same in the paralytic as in the mechanical type. Meteorism is as pronounced in the early stage of paralytic, and particularly in the peritoneal or inflammatory type, as in mechanical ileus. Coprostasis is the same. Borborygmus is always *absent* in the paralytic type. It is one of the most pronounced manifestations of mechanical obstruction of the intestine, and a stethoscopic examination in a case of mechanical obstruction gives more information than one of the chest for lesions of the lung. Absence of sounds means absence of muscular contraction. Mechanical ileus, up to the first, second, third, fourth, or fifth day, has declining frequency in borborygmus, but this can be excited at any time by massage or deep percussion of the abdomen.

The author at one time believed that hyperleukocytosis was of great value in the differential diagnosis; that the infective type would show a high and the mechanical type a low leukocyte count. He has been greatly disappointed, having seen a 36,000 leukocyte count in mechanical ileus; he has also seen a 7000 leukocyte count in a case of septic peritonitis, so he has ceased to regard it as other than of corroborative value.

What should our treatment be in cases of ileus from circumscribed and general peritonitis? It should be immediate laparotomy. By this means, in cases of circumscribed peritonitis, the cause may be eliminated and the inflammation prevented from becoming general; not that all cases would die immediately as a result of the disease, but that the immediate and remote dangers without operation are very much greater than with operation. In general peritonitis the danger is great both with and without operation, but it is my firm conviction that an early operation—that is, an operation within twelve or twenty-four hours after the onset of the symptoms—will save practically all of the cases. *An operation in the late stage, when the patient has cold extremities, capillary cyanosis, is pulseless at the wrist, has projectile vomiting, and dissolution is imminent, should be discouraged, as it does not benefit the patient and brings discredit to surgery.*

The results of the writer in forty-two consecutive cases of perforative suppurative peritonitis (general) show what can be accomplished by operation. There was only one death, and that from double pneumonia six days after operation. This includes every case that presented itself early or late. The greatest stress should be laid on the importance of early operative interference.

Cases of adynamic ileus have only recently been brought to the attention of the

surgeon, but from the illustration of the varieties given it will be seen that there is a fertile field for intelligent surgical interference, based on accurate diagnosis.

Uremic ileus diagnosis is made by the urinalysis and history.

Tabes can be differentiated by a close analysis of the history, but numbers of these cases have been operated upon for ileus.

Fat necrosis has usually profound collapse, intense pain, and great hypersensitiveness and great muscular rigidity in the epigastrium. After the abdomen is opened the gray or yellow patches on the peritoneum and intestine indicate the diagnosis.

Dynamic Ileus.—Dynamic ileus or ileus from spasmodic contraction of the muscular wall occurs first from ptomain intoxication, as that obtained from cheese, milk, ice-cream, oysters, etc., and second from chronic lead poisoning. In the former the pain is intense and often relieved by pressure. The vomiting is incessant; tenderness absent; abdomen retracted; inability to move the bowels; patient collapsed. These symptoms may continue until death, which occurs from toxemia. If the patient survives the immediate effect of the poison it is usually followed by severe gastro-enteritis.

In making a diagnosis of lead poisoning we have to assist us the occupation of the patient, the history of previous attacks, the blue line of the gums, etc. But the increased peristalsis, the local meteorismus, the distinct localization of the pain, make it difficult to exclude mechanical obstructions.

Mechanical Ileus.—In the diagnosis of internal strangulation, no matter from what cause, we have the same symptoms as in strangulated hernia, but the physical signs are different. The symptoms of internal strangulation are as follows: Pain in the abdomen which comes on suddenly, gradually increasing in intensity for the first half hour, followed by nausea and vomiting, and inability to produce bowel movement. If the strangulation be severe, there is an increase in the frequency of the pulse (but, as a rule, in the early stage the pulse is not accelerated), absence of temperature, absence of tenderness. As the case advances, if the strangulated coil be large, it can be recognized through a moderately thin abdominal wall by its distention; the coil of the intestine leading to it may also be recognized by a circumscribed elevation of the abdominal wall. In twenty-four hours all of these symptoms will have increased in severity. The distention of the coil is greater, the abdomen is more tympanitic, sensitiveness at the seat of obstruction is now manifest, and the increased resistance of the occluded coil may be felt. If the coil be small, the increased resistance of the intestine on the proximal side of the occlusion may be felt and a circumscribed dullness may be outlined. This varies with position, depending upon the portion of the intestine involved in the strangulation, as shown in the von Zoege-Manteuffel¹ plates. Peristalsis is very greatly increased and is most pronounced in the neighborhood of the obstruction. The increase in peristalsis continues until peritonitis sets in, when it entirely disappears. If the strangulation be sufficient to produce gangrene, the depression will be more marked, but the local manifestations

¹ Von Zoege-Manteuffel: "Zur Diagnose und Therapie des Ileus," Arch. f. klin. Chirurgie, xli, 1891, 565.

symptoms continue for about two hours, when they gradually diminish. The vomiting persists, but is less severe. After twenty-four hours blood may be detected in the stools. A distinct oblong tumor may be found in the right hypochondriac region just below the margin of the ribs; no bowel movement can be produced. The invaginated bowel may protrude from the anus; there may be a single, double, or even triple intussusception. The most common position is in the ileocecal valve (Fig. 621).

When the *obstruction is due to a gall-stone or foreign body in the intestine*, the symptom of vomiting is very marked, the meteorismus and the depression are less, as the foreign body constantly changes its position and advances further in the intestinal canal. It may form a diverticulum and remain stationary for days or months. Again, it must be borne in mind that moving bodies and not stationary ones give colic.

We have in *strangulated hernia* the same symptoms as in internal strangulation, and in addition thereto we have a history of hernia, and the presence of an irreducible tumor. The peristalsis is increased and there is an absence of induration in the abdomen, except where peritonitis is present; then there is a marked induration about the seat of obstruction and an absence of peristalsis in that region.

The characteristic signs of infective peritonitis following strangulated hernia are, in addition to the usual symptoms of obstruction, *elevation of temperature, absence of peristalsis* near the position of obstruction, and *induration*.

Strangulation of the omentum produces usually the same symptoms as an intestinal obstruction, which may continue for two or three days, depending upon the degree of strangulation, and if sufficient to produce necrosis the symptoms continue until gangrene is complete. This may occur without producing a suppurative peritonitis or even an infection of the sac, and

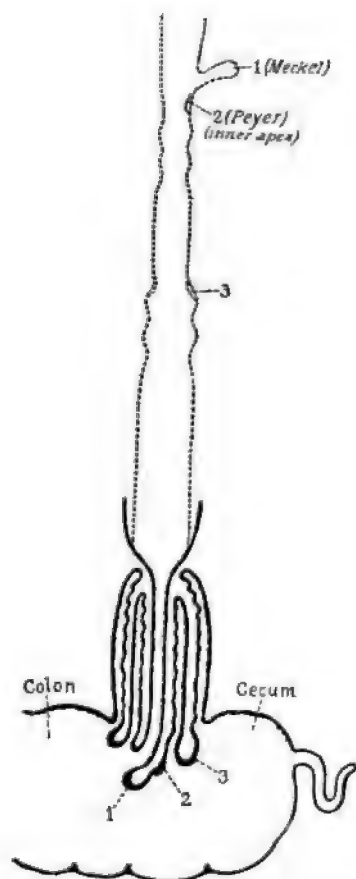


FIG. 621.—DIAGRAM OF TRIPLE INTUSSUSCEPTION ORIGINATING IN MECKEL'S DIVERTICULUM AT THE ILEOCECAL VALVE (Carwardine).

1, Meckel; 2, (Peyer) inner apex; 3, outer apex.

subsequent absorption may take place. It is not uncommon, however, to have an incarcerated or strangulated omentum suppurate, in which case it should not be reduced, but excised. The same principle should govern its non-operative reduction that governs that of a strangulated intestinal hernia, that is, a hernia of more than thirty-six hours' duration; in neither should reduction ever be attempted except by operation, when the hernial contents can be inspected.

Another danger following reduction of hernia is that it may be returned *en bloc*, or a small knuckle may be allowed to remain in the ring; in these cases the symptoms of obstruction do not subside after the reduction, and it should be the rule that in all cases of reduced hernia, where the symptom of vomiting continues for six hours after reduction, a laparotomy should be performed.

As an illustration of incomplete reduction the following is a most instructive case, referred to me by John W. Hanna, of Winfield, Iowa.

Patient admitted to St. Joseph's Hospital December 30, 1894. Six days previous when he alighted from his buggy the hernia came down. It was more painful than usual; it was reduced a short time after, but the pain continued and he soon began to vomit. When seen by Hanna five days after the accident the patient's abdomen was tympanitic, the vomiting had continued; the pain was slight, and in the five days the bowels had not moved. Examination revealed the inguinal canal apparently free. The patient presented the same symptoms when he came under my observation in the hospital, except that a small hard nodule could be detected on the inner side of the right inguinal ring. The finger could pass freely into the canal without obstruction. The nodule was sensitive to pressure and very hard. The scrotum was full of fluid, which the patient believed was from an old hydrocele.

Operation: Hernial sac opened, found empty. Incision extended up into abdomen; just below the outer pillar at the point of induration was found a knuckle of intestine passing from the hernial sac through a very narrow opening into the hydrocele sac. The abdomen contained a considerable quantity of serous fluid. Before the hydrocele sac was opened the field was well packed with gauze and preparations made for a resection of the bowel. Hydrocele sac was opened and was full of very offensive pus and feces; it contained a Richter hernia involving four-fifths of the circumference of the bowel, which was gangrenous and had perforated. Resection of five inches, end-to-end approximation with button, and mass returned to abdomen. The hydrocele cavity was left open and packed with gauze. Patient's condition when removed from the operating table very good. Within the next eight hours after operation he had six bowel movements, but his pulse began to increase. He had no pain, tenderness, tympanites, nor vomiting. His expression became anxious and he died thirty hours after the operation from autointoxication.

We have in this case a striking illustration of the importance of operating where the symptoms of vomiting continue after the non-operative reduction of the hernia. Furthermore, we have an additional illustration of death from autointoxication from the absorption of the decomposed proteids that have been retained in the intestinal canal. In this case it could not be attributed to the thrombosed veins, as they were resected. The drainage of the proximal coil at the time of operation is a life-saving procedure. The Moynihan glass tube insertion method or multiple puncture may be resorted to.

TREATMENT.

The treatment of ileus must necessarily depend upon the differential diagnosis or etiologic factor in the production of its symptoms. The treatment may well be divided into three classes, corresponding with the classification of ileus given

above. The *adynamic type* requires no surgical treatment as far as the ileus itself is concerned. Still each of its subdivisions has distinct and clean-cut therapeutic indications, many varieties necessitating immediate surgical intervention not for the intestinal obstruction but for the pathologic conditions producing the symptoms of ileus. In fractures of the spine and injuries to the afferent nerve the abdominal distention is relieved by paralyzing the sphincter ani by overstretching, as in the operation for hemorrhoids and by passing a high rectal tube. In from five to seven days after the fracture peristalsis is restored and the distention rapidly subsides. Occasionally the tympany is so great as to compromise respiration and cardiac action, necessitating an enterostomy. Reflex ileus is relieved by large doses of morphin and atropin combined, or the latter alone, $\frac{1}{80}$ to $\frac{1}{30}$ grain doses. The salicylate of physostigmin and eserine in large doses, $\frac{1}{80}$ to $\frac{1}{30}$ of a grain hypodermatically, have a similar effect in the restoration of intestinal peristalsis. The cause of the reflex ileus should be removed, whatever it may be, whether it be a gall-stone, renal calculus, strangulated omentum, etc. In the diaphragmatic pleurisy ileus large doses of morphin have the best effect. *None of these drugs, however, should ever be administered until a positive diagnosis of the etiologic factor is made*, as morphin would obscure the symptoms of a mechanical as well as those of a reflex ileus and contribute nothing to its cure. In the ileus of intra-abdominal infections, early drainage with removal of the cause of the infection is essential to the relief of the symptoms. It is of vital importance to the patient that it be timely. It should be borne in mind that one of the most important symptoms in the differentiation of this from the mechanical type is the uniform elevation of temperature in the septic variety and its invariable absence in the mechanical variety. Gastric lavage gives great relief to the patient in all types of adynamic ileus.

The *dynamic type* is relieved by morphin, atropin, and eserine. The elimination of the lead when this is the cause should be favored by every possible means to prevent a recurrence of the attacks. Susceptible patients should change their occupation. In the ptomain and tyrotoxin poisoning gastric and intestinal lavage with proctoclysis may tide the patient over the period of danger. Here morphin should never be given, as it lessens peristalsis and retards elimination, thereby increasing the duration and degree of absorption.

The treatment of *mechanical* ileus consists in the mechanical removal of the cause of the obstruction. This presupposes a positive differential diagnosis which requires a most careful analysis of the symptoms, the time of their onset, the frequency of their manifestation, the rapidity of their increase, their location, etc. Even those most experienced can err as to the etiologic factors. The most frequent errors occur in differentiating mechanical ileus from (a) cholelithic colic, (b) ureteral colic, (c) tabetic crises, (d) torsion of tumor pedicles, (e) acute pancreatic fat necrosis, (f) peritonitis, appendical, perforative (of the stomach, intestine, gall-bladder, tubes, etc.). It is embarrassing to the surgeon after he has exercised all means of diagnosis to operate and find that the case is one of the above and not one of true

mechanical obstruction. But that sin of commission is venal and rarely committed compared to the frequent mortal one of ("conservative") omission.

When operation is deferred, deferred, and deferred until the patient is collapsed, it then offers no hope. There has been no treatment so far instituted that materially reduces the mortality in cases suffering from collapse at the time of surgical intervention for mechanical obstruction: they practically all die. The physician and surgeon, therefore, must be keen as to the situation and see that surgical relief is given before the symptoms of collapse manifest themselves. Morphin, atropin, and eserine are all equally worthless in mechanical ileus; they are worse than that, for they encourage delay, dispel the symptoms and signals of danger, and give hope when none is justified by their administration.

Frequent gastric lavage relieves the emesis, retards collapse, and should be resorted to only while the patient is being hurried to the operating table, for while gastric lavage relieves emesis and retards the collapse it also retards the operation by giving the surgeon and patient relief from the condition and becomes therefore an element of danger to the patient. The circumstances under which this is most dangerous is the *post-operative mechanical ileus*. It leads one on and on in the delusion that the patient's condition is improving, while in reality the mechanical obstruction continues; the patient's pulse then suddenly rises to 130 or 140, the abdomen is reopened to reveal the lamentable destructive effects of the prolonged strangulation of a coil of bowel; it is freed with or without resection and still the patient promptly dies from that fatal and so far irremediable collapse. When post-operative emesis is recurrent after forty-eight hours and not relieved by a single or double gastric lavage; with gastric tetany and a few other common conditions excluded, the patient should then and there be reopened.

The treatment of mechanical ileus must consist in the early mechanical removal of the obstruction. In contrasting the statistics of recoveries from ileus by the medical and operative treatments, one must not be led into the belief that a mechanical obstruction often relieves itself or is often relieved by medical treatment. The latter I believe is never true, the former rarely occurs. The reason for the common belief in the profession that treatment relieves mechanical ileus is entirely due to the fact that a differential diagnosis has not been made between the mechanical and the dynamic and adynamic varieties. There is no "palliative" or conservative treatment for mechanical ileus—"criminal procrastination" is the proper term for this so-called treatment.

There is a preparatory treatment mentioned above to be carried out while rapid preparations are in progress for an efficient operation by a competent operator. The details of the operative procedures for mechanical ileus are given under separate headings to follow.

Towel Method of Replacement.—Surgeons of experience know how difficult it is to replace the bowels after they have been out for a considerable length of time during an operation for obstruction, even when protected by hot applications. The causes of this difficulty are: (1) Usually before the operation the bowels are

full of gas (tympanitic) from the diseased condition demanding the operation. (2) During the exposure the intestinal wall becomes edematous and a large transudation of fluid into the intestinal canal takes place. The bowel when eviscerated is light and its wall thin and pliable; in half an hour it becomes heavy and sodden, resembling sausage. These changes make it difficult to replace the intestines into the abdominal cavity. Some operators resort to puncture of the bowel to relieve the distention and thus facilitate the replacement. In a number of cases I have used the following method of returning the bowel. Cover the entire intestinal mass with a hot towel, placing the edge of the towel inside the margin of the wound all the way around. This acts as an artificial abdominal wall and resembles an enormous ventral hernia with a large neck or opening. The operator and assistant then work or press the edge of the towel under the wall on all sides with the fingers, at the same time elevating the abdominal wall with retractors, thus forcing the mass down to a level with the abdomen. The reduction is effected in this manner as easily as a hernia is reduced after the ring has been enlarged. The sutures are then inserted, and as they are tied the towel is gradually withdrawn.

Collapse and depression in association with intestinal obstruction may be divided into three classes: (a) Primary shock or collapse, due to the reflex effect of the trauma to the strangulated coil, intussusception, or volvulus. This primary shock is more pronounced the nearer the strangulation is to the origin of the jejunum, the greater the coil, and the greater the tension under which the contents of the strangulated coil is held. (b) Intermediate depression, collapse, or shock; a mild degree of cyanosis, gradually increasing, associated often with persistent vomiting; the collapse and the vomiting are less the closer the obstruction is to the origin of the jejunum. This depression is due, we believe, to the continued vomiting, distention, and absorption which take place above the point of obstruction. (c) Post-operative collapse, usually a sequence of late operations, occurs either with or without resection of the bowel, and without peritonitis. It begins to assert itself shortly after operation, is not associated with vomiting, and proceeds to a fatal termination six or eight hours after the bowel has been freed. Since 1892 we have maintained that this collapse is due to the absorption of the poisonous intestinal contents which starts in suddenly both above and below the point of obstruction after the bowel has been freed. The conditions are relieved (a) by hypodermic injections of anodynes, which should never be given except preparatory to operation; (b) by repeated gastric lavage and proctoclysis, also preparatory to operation; (c) by opening the bowel above the point of obstruction, thoroughly emptying it over a glass (Moynihan) or rubber tube at the time of the operation; this should be followed by repeated gastric lavage and proctoclysis immediately after the operation. The technic of proctoclysis is as follows:

1. A 2-quart fountain syringe should be attached to the head or foot of the bed, and elevated from 4 to 18 inches as required to counteract the intra-abdominal pressure.
2. The vaginal hard-rubber douche tip flexed at 35 degrees (2½ inches from the end) should be inserted into the rectum. This should be attached to a rubber tube

which is secured to the thigh with a firm adhesive strap so as to prevent displacement of the tip.

3. Salt solution at a temperature of 100° should be allowed to flow in until $1\frac{1}{2}$ to 2 pints have been taken. This should require at least sixty minutes, and must be controlled by the elevation of the syringe and never by a forceps applied to the tube to lessen its lumen, as this would prevent a rapid return flow to the can or escape of gas, should the patient cough or strain. The quantity should be repeated every two hours. Never remove the rectal tube except for defecation. When the fluid is not retained it is improperly given. I have had a

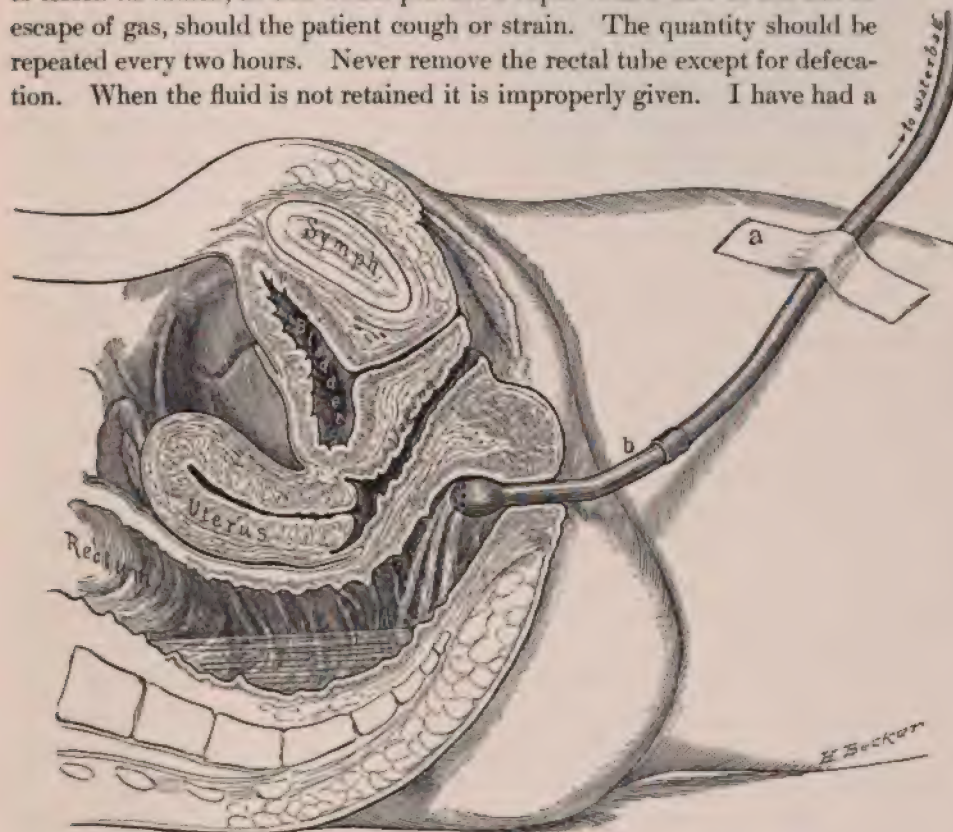


FIG. 622.—MURPHY'S METHOD OF PROCTOLYSIS.

a, Adhesive plaster fastening the tube to the inner aspect of the thigh; b, rubber tube with tip inserted in the rectum.

child retain 30 pints in twenty-four hours. Tide the patient over the immediate effects of the toxemia the same as over acute alkaloid poisoning and he will recover.

POST-OPERATIVE INTESTINAL PARALYSIS AND INTESTINAL OBSTRUCTION.

Post-operative ileus is unfortunately far from rare. Fritsch,¹ for example, lost 1.6 per cent. of all laparotomies from post-operative ileus.

To better understand the etiologic factors of post-operative intestinal obstruction the condition must be divided into two distinct classes:

¹Fritsch, H.: Bericht u. die Gynakolog. Operationen d. Jahrg. 1891-1892, p. 213.

(a) Adynamic or functional paralytic ileus.

(b) Mechanical or organic ileus.

The former of these classes is due to intestinal paresis, trauma, exposure, fixation, peritonitis, mural infiltration, and over-distention of the walls of the bowel.

Organic ileus is caused by protrusion of intestine into peritoneal pockets; transfixion of the intestine while closing the wound; compression of the coils between the stitches; incarceration of a loop in a hole in the omentum or mesentery; inclusion of a coil of intestine between the margins of the wound after vaginal hysterectomy; plication of the intestinal wall due to several abraded areas; volvulus; bands of adhesions compressing the bowel; hematoma of the lower pelvis following vaginal hysterectomy; necrosis and cicatrices following trauma of the mesentery; accordion plications with adhesions, etc.

The following classification will facilitate the understanding of the etiologic factors of post-operative ileus:

1. Trauma of the peritoneum and intestinal wall, including also simple exploratory operations.
2. Reflex causes, such as the ligation of pedicles, tension sutures, etc.
3. Agglutination of the intestinal coils.
4. Peritonitis.

Intestinal paresis and paralysis are due most frequently to peritonitis. Reichel¹ found that after a laparotomy the peritoneum may be infected by bacteria, not only from without, but also from within the bowel. Multanowsky² has proved that in case of arrest of the feces in the intestine, the colon bacillus and many other species of bacteria may, after this has persisted for six hours, pass through the wall of the intestine and infect the peritoneum, even though the serous coat of the latter is intact. This I have demonstrated many times in the sacs of strangulated hernias.

During laparotomies the intestines, almost or completely collapsed at the beginning, may become distended toward the close. Fritsch³ attributes this to the swallowing of air during narcosis. In 1896 we demonstrated experimentally that the enlargement is due to venous and peristaltic stasis. When the intestines are pushed back forcibly, a kink may result, and becoming adherent produce obstruction.

The **diagnosis** of post-operative intestinal obstruction is sometimes easy, the cardinal symptoms—pain, vomiting, coprostasis, and meteorism—being classic. Again, the diagnosis may be very difficult when the clinical picture is that of peritonitis. Veit states that when the first week is afebrile, and such symptoms occur later, it is suggestive of post-operative ileus. In septic peritonitis the symptoms of ileus last for three, four, five, or six days, during which time it is impossible to secure a fecal evacuation. Very often just before death there is active peristalsis with a watery discharge. This to the inexperienced is a favorable omen, while it should be interpreted as a precursor of death.

It is at times very difficult to differentiate the adynamic variety of post-operative

¹ Reichel: "Die Entstehung der Missbildungen der Harnblase und Harnröhre," *Centralbl. f. Chir.*, 1894, xxi, 823.

² Multanowsky: *Inaug. Dissert.*, St. Petersburg, 1895.

³ Fritsch: *Op. cit.*

obstruction from the mechanical. As a result of clinical experience, however, we have learned that in the adynamic form the symptoms appear early, rarely later than forty-eight hours. Vomiting is marked in the beginning, but diminishes with time; the pain is not of a colicky character and collapse is present, but not as early as in the mechanical form.

Treatment.—I am fully convinced that the prejudice of the previous decade not to reopen the abdomen was erroneous, and has contributed materially to the post-operative mortality. At present if a patient presents himself at a hospital with symptoms of ileus or any other serious abdominal manifestation in which no definite diagnosis can be made at once, he is immediately laparotomized. Few surgeons, however, reopen the abdomen when the same train of symptoms follows a laparotomy in time to save the patients from the disastrous results of the post-operative obstruction. The surgeon is often chagrined to find from the necropsy that the condition causing death was purely mechanical or one which could have been readily rectified by an operation.

The treatment of post-operative ileus can be classified as medical and surgical. Before entering into a detailed consideration of the treatment, I wish to call attention to the fact that while abdominal distention after operation is generally considered a manifestation of retention, we estimate this immediate distention as of prophylactic value against organic fixation and paralytic ileus. It seems to be Nature's effort to prevent post-operative ileus. As a general rule, in traumatic peritonitis the ileus subsides in a comparatively short time; in septic peritonitis it is entirely different—the ileus is pronounced and prolonged. Associated with elevation of temperature, rapid pulse, anxious expression, and the other symptoms making up the clinical picture of septic peritonitis, the treatment should be: drainage, streptolytic serum, continuous proctoclysis with normal salt solution, inunctions with unguentum Credé, and Fowler's position. The ileus is only a manifestation of the peritonitis.

In order to prevent post-operative ileus many operators advise giving a purgative a few hours before the operation; it does not seem to make any material difference which purgative is chosen. In my practice I do not follow this method. If some time after the operation, say six to twelve hours, or the next day, the patient has nausea or vomiting, gastric lavage is resorted to and is very effectual in relieving the distress. In order to stimulate peristalsis calomel is given in fractional doses after the operation— $\frac{1}{2}$ or $\frac{1}{4}$ grain every fifteen or twenty minutes until from 1 to 2 grains have been taken. This is followed by a saline. When there is a paralysis of peristalsis strychnin is administered in $\frac{1}{3}$ to $\frac{1}{2}$ grain doses. Arndt,¹ of Posen, followed by many others, effectually used eserine salicylate, 1 to 2 milligrams ($\frac{1}{60}$ to $\frac{1}{30}$ grain), in twenty-four hours in case of threatened or pronounced adynamic post-operative ileus with good results. Physostigmin salicylate is equivalent to eserine and should be given hypodermically in $\frac{1}{60}$ -grain doses repeated every hour or two for as many as six doses. Hypodermic injections of $\frac{1}{60}$ gr. of atropin sulphate fre-

¹ Arndt, Gustav: "Das Eserin in der Behandlung der Postoperativen Darmparalyse," *Ztrb. f. Gyn.*, 1904, No. 9, S. 273.

quently relieve the post-operative colic. These medications, however, are applicable only to the adynamic type or wind colic varieties of ileus, and have no effect in the mechanical variety.

Hardon¹ reports that 42 per cent. of the deaths in abdominal surgery in his first seven years of practice was due to "intestinal paresis." In the last nine years of his practice he has had no cases of paresis, which he attributes to the beneficial effects of enemata 1 to 2 pints of alum solution, 3 to 5 per cent., given shortly after the operation. This agent is known to increase the peristaltic activity. In a limited experience I have also found it very efficacious.

Post-operative ileus is rather a rare occurrence in the writer's practice, and this he attributes to the scrupulous avoidance of trauma during the operation, as well as to the post-operative management of the cases. Shortly after every prolonged, severe, or septic laparotomy, except in those where intestinal approximation or anastomosis of the large intestine has been performed, continuous proctoclysis is practised as described above.

In the presence of mechanical ileus when meteorism, coprostasis, and pain extend beyond forty-eight hours, the treatment must not be expectant. Reopening of the abdomen is indicated particularly when there is no elevation of temperature. If post-operative ileus follows a vaginal hysterectomy, there is no occasion for making an abdominal incision. The vaginal packing or the clamps (if these have been used) can be easily removed, the cause detected, and the obstruction overcome.

Operative Treatment.—When the obstruction is not overcome by the treatment described in the foregoing section, the abdomen should be reopened in the operating room, with all the preparations and precautions that are resorted to in primary sections. The stitches should be freely removed and the site of the former operation carefully inspected, as a collection of blood or wound-secretion may be found compressing the bowel. Search should be made for a coil of distended intestine, leading to a collapsed zone. It should be borne in mind that the large intestine is often distended when the obstruction is above the ileocecal valve. In the small intestine the point distal to the point of obturation is always collapsed. The collapsed coils should be lifted up and rapidly run through the fingers within the abdomen until they cease to come freely, when a careful examination will reveal the cause of the obstruction, which should be removed, the intestine straightened out, and, if necessary, a resection should be made of severely strangulated coils. The liberation must continue along the coil until the distended zone is reached, otherwise a second obstruction might be overlooked.

The obstruction is not always at the seat of operation; for example, eight days following an operation for ruptured ectopic gestation the usual train of symptoms of ileus presented themselves. A careful separation of all the adherent intestines, blood-clot, tube, stump, etc., failed to reveal the junction of the distended portion with the collapsed coil. Proceeding upward to the jejunal mesentery the writer found a volvulus including 4 feet of jejunum. This was held securely in its place

¹ Hardon, V. O.: "The Alum Enema in the After-treatment of Abdominal Operations," Amer. Jour. of Obstet., 1901, xliii, p. 786.

by slight adhesions. These were separated, the bowel restored to its normal position, and the patient recovered.

It is surprising to see how apparently friable adhesions will hold the intestine firmly enough to produce obstruction.

There are three points at which obstruction may occur, which are usually overlooked. These are: (1) The duodenojejunal fossæ; (2) the cecal fossæ; and (3) the sigmoid fossa.

When the intestine is incarcerated in either of the first two, it is likely to be overlooked and its fixation attributed to the normal mesenteric attachment at these positions, on account of their relation to the normal anatomic upper and lower terminations of the small intestine, while in reality the bowel has become strangulated in one of these peritoneal pockets. This error is more common in the examination of post-operative than in the primary variety of ileus.

If septic peritonitis is present it will be benefited by the opening of the peritoneum, lessening, as the latter does, the tension of the infection products, diminishing the absorption, and often furnishing life-saving drainage, though laparotomies for post-operative are not at all as successful as those for primary septic peritonitis. If the distention of the coils of intestine is great, it may be relieved by many punctures with a hollow needle; these should be sutured at once. This method is better than an incision, and should be performed rapidly. There is less danger of infecting the peritoneum by a secondary opening than by a primary one, as its local resistance has been developed by infiltration (which means local resistance) from the first intervention.

Drainage may or may not be used following the second operation. Its use is governed by the same indications as in the primary operation. A secondary operation permits primary union of the wound margins as readily as the first one.

The high mortality of secondary laparotomies is due not to the operation itself, but to the fact that the *secondary operation is delayed until irreparable pathologic conditions have developed*. Secondary openings should be made whenever the post-operative symptoms are inconsonant with the usual process of repair from the pathologic conditions found in the primary operation. It may seem needless to warn against mistaking acute gastric dilatation or symptoms of uremia for mechanical ileus, but this has frequently occurred.

ULCERS.

The alimentary canal is a favorite seat of ulceration, and while no portion is exempt, there are favored ulcer zones.

Peptic Ulcer; Round Duodenal Ulcer; Ulcus Duodeni Pepticum (Leube¹).—This variety is less common than the gastric (as 1 : 12, Burwinkel²; 1 : 3, Mayo³),

¹ Leube, O. W.: "Die Krankheiten des Magens und Darms." Von Ziemssen's Handbuch, 1876, vii, 2.

² Burwinkel, O.: "Klinische Beobachtungen über das peptische Duodenalgeschwür," Deutsch. med. Woch., 1898, xxiv, Nr. 52, 823.

³ Mayo, W. J.: "The Surgical Treatment of Gastric and Duodenal Ulcer and Its Results," Jour. Amer. Med. Assoc., 1906, xlvii, 912.

and, unlike the latter, is most frequent in men (3 : 1). It is not infrequently associated with gastric ulcer—a matter not to be overlooked.

The corrosive action of the gastric juice is not limited to the stomach, but attacks the esophagus occasionally and the duodenum frequently, rarely the jejunum after gastro-enterostomy.

Duodenal ulcers are located most frequently in the upper part of the duodenum before the acid chyme has been neutralized by the bile and the pancreatic juice. If situated at the pylorus, they may involve both the gastric and duodenal mucosæ and assume an hour-glass shape. The anterior wall of the duodenum is the most common site; they are usually single, though as many as thirty have been observed in one case. W. J. and C. H. Mayo,¹ who have had a most extensive experience, observed one hundred and thirty-five cases of duodenal ulcer to twenty-eight cases of gastric and duodenal ulcers combined. Of these, 77 per cent. were in males and 23 per cent. in females. In all but five cases the bowel lesions were single.

These ulcers are most common between the ages of thirty and sixty; unlike the gastric variety, which is very rare in children, the duodenal variety is somewhat common under ten. They have even been found in new-born babes who had survived but a few hours, hence they may arise *in utero*. The etiologic factors which give rise to duodenal ulcers, though not definitely known, are apparently the same as in the gastric type. They may be grouped in the order of their importance as follows: Hyperchlorhydria, local infection, embolism or thrombosis, and foreign bodies. Autodigestion of a zone of ischemic mucosa appears to play the most important rôle in the production of gastric and duodenal ulcers. In size the ulcers vary from 1 to 3.5 cm. in diameter. If perforation takes place, the opening is usually much smaller than the ulcer itself, being rarely larger than 0.6 cm. in diameter. The small ulcer is more prone to deep destruction and perforation than the large. They generally perforate into the free abdominal cavity, without inducing protective adhesions of the neighboring viscera before perforating; in rare cases into the pancreas, the liver, the gall-bladder, or some of the large blood-vessels in the vicinity. In the former the fluid escaping from the viscus is free to run at large in the abdomen. In many cases a well-defined path is taken. The fluid (generally mucus more or less tinged with bile) escapes upon the upper surface of the transverse mesocolon to the right of the hillock which is formed by the fitting in of the transverse colon to the greater curvature. It, therefore, tends to run to the right on the hepatic flexure and then to descend to the iliac fossa along the outer side of the ascending colon. Collecting there, it may cause symptoms strongly suggestive of appendicitis, and has been frequently erroneously diagnosed as such. From the iliac fossa the fluid drains to the pelvis, and, filling that, overflows into the left iliac fossa. If an abscess forms it may be bounded by lymph, agglutinations or adhesions of liver, intestines, omentum, etc.

That duodenal ulcers heal spontaneously is proved by post-mortem findings.

¹ Mayo: Loc. cit.

The tendency to the development of carcinoma in the scars is not nearly so great as in gastric ulcer, though authentic cases are recorded in the literature.

The *symptomatology* is notoriously uncertain and inconstant. Of one hundred and fifty-one cases collected by Perry and Shaw,¹ ninety-one gave rise to no symptoms of moment until hemorrhage or perforation took place. The pain in general may be said to resemble that of gastric ulcer, but it is usually much less severe, because the duodenum is more fixed and the stomach contents are less irritating. In some cases it is merely a sense of discomfort, while in few it is severe and intolerable. Its character is burning or "boring," and it may radiate down and to the sides; seldom or never to the back. It comes on from one-half to six hours after a meal, but is characteristic when it makes its appearance from two to four hours after a meal. In some cases the pain has been sudden in its onset and colicky, resembling the colicky type of gastric ulcer, so often emphasized by us, and also mimicking that of gall-stones.² In our observations demonstrated by the pathologic findings at the operation, one of the contrasting characteristics between the pain of gastric ulcer and that of duodenal ulcer is that in the former the pain is immediately increased—if affected at all—by the food (except where the ulcer is in the pyloric zone), while in the latter the pain is promptly relieved by the ingestion of food, as it causes a suspension of chyme transmission through the pylorus.

Hemorrhage may manifest itself either through the stomach or bowel; in some cases hematemesis or melena is the first symptom to attract the patient's attention. It is found in 26 per cent. of the acute and 40 per cent. of the chronic ulcers (Fenwick³).

Vomiting is relatively rare. It occurs in about 17 per cent. of the cases (Oppenheimer⁴), and is not usually characteristic unless it comes on from two to four hours after a meal. It often takes place at the height of the painful paroxysm, and is not always dependent on taking food.

Icterus is rare. When present, it may be due to swelling of the mucosa of the common duct in the acute cases, or to cicatricial occlusion in the cases of long standing. Other symptoms which have been reported are: (a) Digestive disorders, usually resembling hyperchlorhydria, or less frequently gastric catarrh; (b) paroxysmal dyspnea, the origin of which, though not certain, is probably reflex; (c) neuralgias, also reflex, affecting various portions of the abdomen and chest; (d) cardiac palpitation.

The *course* of the great majority of cases is essentially chronic and slowly tends toward spontaneous recovery. In some cases, however, as previously pointed out, the first symptom may be a profuse or even fatal hemorrhage, or the sudden development of a general peritonitis due to the perforation of the ulcer.

¹ Perry and Shaw: "On Diseases of the Duodenum." Guy's Hospital Reports. 1893, xxxv, 171.

² Graham: "Diagnosis between Duodenal Ulcer and Gall-stone Disease," Jour. Am. Med. Assoc., Feb. 9, 1907, 515.

³ Fenwick: "Ulcer of Stomach and Duodenum." Philadelphia, 1900.

⁴ Oppenheimer: Inaug. Dissert., Wurzburg, 1891.

The *treatment* of the acute ulcer is medical; surgery has to do only with the complications, such as hemorrhage and perforation (Mayo). Secondary cicatricial stenosis is more common than is usually believed, and results in enormous dilatation, even involving the stomach. The duodenum may be larger than the stomach and the pylorus mistaken for hour-glass contraction (see the illustration of Cordes's case). When perforation takes place, the patient should be operated on as soon as possible, as the statistics show that the earlier the operation, the greater the chances for recovery. The Mayos have made one hundred and thirty-five "no-loop" gastro-jejunostomies, with but one death.

In these cases it is very desirable to make a definitive occlusion of the pylorus. This can best be done on its duodenal side by freeing it from its mesentery to the extent of $\frac{3}{4}$ inch, crushing it with two hysterectomy clamps closely applied, and dividing the duodenum between the clamps. A ligature is then placed on each crushed zone, and will have in its bite only the fibrous layer of the bowel. This can be readily involuted with two rows of continuous Pagenstecher linen sutures. The whole operation occupies but a very few minutes, and permanently protects the duodenum from the gastric secretion.

Follicular or Catarrhal Ulcer.—This variety occurs in acute or chronic inflammation of the intestine, and is not so common in the small as in the large bowel. This ulcer is not deep and it soon heals; it is, therefore, of slight surgical importance.

Stercoral Ulcer; Decubital Ulcer (Grawitz¹).—This is found nearly exclusively in the large bowel, where the fecal current is slowed or scybalous masses irritate—the cecum, hepatic and splenic flexures, and the sigmoid. For this reason they are also common above strictured portions of the intestine. They may be shallow or deep. They are catarrhal in nature and may be followed by stricture.

Typhoid Ulcer.—While this variety is found mostly in the ileum, it may invade the gall-bladder, the stomach, and even the pharynx. They are usually opposite the mesenteric attachment and vary in number up to thirty-six. Typhoid ulcers usually assume the shape of the Peyer's patch, but as only part of the patch sloughs off, the resulting ulcer will be very irregularly shaped. The edges are not indurated, as in the border and floor of tuberculous ulcers.

In 577 necropsies they were located: 510 times in the ileum; 247 times in the cecum and appendix; 184 times in the colon; 41 times in the jejunum; 12 times in the rectum (Curschmann²).

Perforation is estimated by Murchison at 21 per cent.; by Curschmann at only 10 per cent.; and by Osler³ at 1.2 to 3.6 per cent., and causes 33.8 per cent. of all deaths from the disease.

Site of the perforation in 167 cases: Ileum, 136 times; large intestine, 20 times;

¹ Grawitz, Paul.: "Statistischer und Experimentell-pathologischer Beitrag zur Kenntniss der Peritonitis," Charité-Ann., 1885, xi, 770.

² Curschmann, H.: "Die Anomalien der Lage, Form und Grösse des Dickdarms und ihre klinische Bedeutung," Arch. f. klin. Med., 1894, liii, 1.

³ Osler, W.: "Practice of Medicine," New York, 1892.

vermiform appendix, 5 times; Meckel's diverticulum, 4 times; jejunum, 2 times (Fitz¹).

The typhoid ulcer becomes surgical only when it perforates the intestine or permits of a peritoneal infection through the lymphatics. In either case the peritonitis should have immediate operative treatment, described in another chapter. The results in the operative treatment of typhoid hemorrhage do not justify its uniform practice for this condition. Operation, however, may be resorted to in exceptional cases with advantage.

Dysenteric Ulcer.—This variety is of various shapes and sizes, either confined to restricted areas, or practically continuous throughout the large bowel. They also vary greatly in size, from minute points up to 1½ or 2 inches in diameter. As a rule, they are transverse to the long axis of the bowel. They may involve the lower ileum, but in general they are found in the large intestine either in whole or in part.

Dysenteric ulcers may perforate, but it is now known that their healing is not attended by contraction of the lumen. This we owe to the researches of the late J. J. Woodward,² who found no stenosis in the enormous amount of material collected by him for the "Medical and Surgical History of the War of the Rebellion." When severe and persistent, an appendicostomy (Weir³) should be resorted to for the continued or repeated lavage of the large intestinal tract. This disease shows at times intense sepsis and great tendency to necrosis; a timely appendicostomy materially lessens the danger and hastens the recovery.

Bilharziosis of the colon is also attended by ulcers, confined to the mucosa.

Tuberculous Ulcer.—These may be primary or secondary. According to Frerichs, tuberculosis of the ileum is found in 80 per cent. of the cases of chronic pulmonary tuberculosis. The tuberculous ulcers are observed principally in the lower part of the ileum and run transversely to the axis of the bowel. Tuberculous deposits may be seen as a white line running from the ulcer into the mesentery. They are of irregular shapes, undermined or smooth. They rarely cicatrize; hemorrhage is infrequent and usually gives a premonitory symptom—sudden elevation

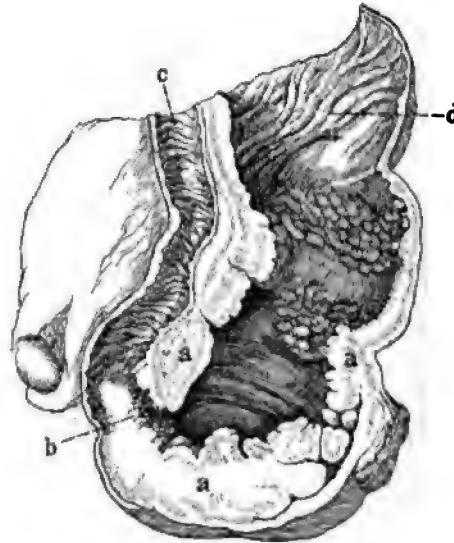


FIG. 623.—TUBERCULOUS GRANULOMA PRODUCING OBSTRUCTION OF THE BOWEL.
a, Cicatricial tissue; b, stenosis; c, distal end; d, proximal end.

¹ Fitz, R. H.: "Typhloenteritis and Appendicitis," Boston Med. and Surg. Jour., 1890, cxxii, 167.

² Woodward, J. J.: "Med. and Surg. Hist. of the Rebellion," Medical vol. i, part 2.

³ Weir, R. F.: Med. Record, Aug., 1902.

of temperature—and is frequently accompanied and followed by intestinal cramps. Perforation is not common (8 to 10 per cent.); it is slow, hence perforation into the free peritoneal cavity is rare; the opening is usually into some recess walled off by adhesions. They occasionally lead to stenosis. This is due (a) to cicatricial contraction (see Fig. 624), and (b) to granuloma occlusion (see Fig. 623).

Fenwick and Dodwell¹ give the following table of frequencies of intestinal tuberculosis, founded on 2000 necropsies at the Brompton Hospital for Consumption and Diseases of the Chest:

Ileocecal region	85.0 per cent.
Ascending colon	51.4 "
Transverse colon	30.6 "
Jejunum	28.0 "
Rectum	14.0 "
Sigmoid	13.5 "
Duodenum	3.4 "

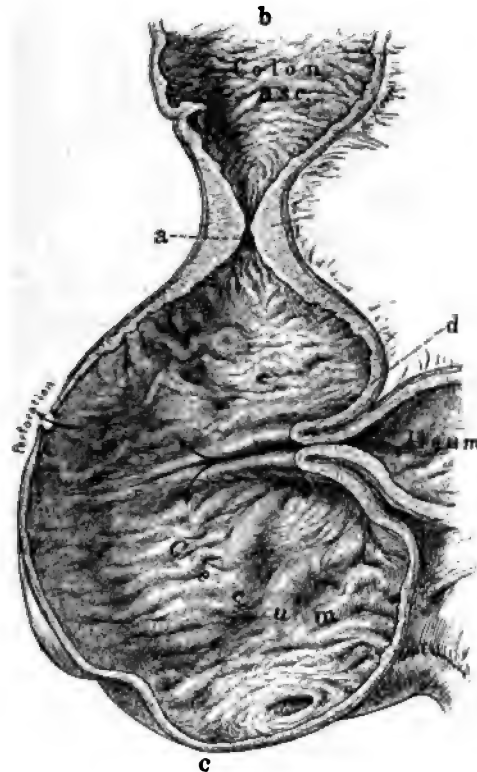


FIG. 624.—TUBERCULOSIS OF CECUM (Cullen).
a, Stricture and shot; b, distal end; c, proximal end; d, ileocecal valve.

Anthrax.—In the intestinal form there is hemorrhage into the stomach and bowels. In Poelchen's² case of five days' standing there were no gastro-intestinal symptoms. The spleen was enlarged, the stomach and intestines both contained ulcers.

Ulcers from Burns.—We owe our knowledge of this variety to Curling,³ of England, who found it present in sixteen of one hundred and twenty-five necropsies, and more often in young individuals. In one of his cases a branch of the pancreatico-duodenal artery was eroded and caused death. Perry and Shaw⁴ found it five times in one hundred and forty-nine necropsies following burns.

It is supposed to be due to toxins produced in the burned area and excreted through the bile. Kijanitzin⁵ claims to have isolated a toxic substance from the blood after burns. These ulcers develop in from seven to fourteen days, but never in the stomach. A similar variety of ulcer has been known to follow frost-bite.

¹ Fenwick and Dodwell: "Perforation of the Intestine in Phthisis," London Lancet, 1892, ii, 133.

² Poelchen, Richard: "Ueber die Aetiologie der stricturirenden Mastdarmgeschwüre," Virchow's Archiv, 1892, cxxvii, 189.

³ Curling, T. B.: "On Acute Ulceration of the Duodenum," Med. Chir. Trans. London, 1842, xxv, 260.

⁴ Perry and Shaw: Loc. cit.

⁵ Kijanitzin, J.: "Zur Frage nach der Ursache des Todes bei ausgedehnten Hautverbrennungen," Virchow's Archiv, 1893, cxxxi, 436.

Embolism and Thrombosis.—This variety is unusual; it is found principally in the small intestine and is very rare beyond the ileocecal valve. It is always due to circulatory disturbances, as occlusion of the smaller branches of the mesenteric vessels as a result of atheroma, endocarditis, phlebitis, etc. The ulcers are small in size, as a rule, round or irregular; occasionally they encircle the bowel.

Uremia.—Duodenal ulcer was found in twelve out of seventy deaths from uremia in Bright's disease. The ulcer is due to the irritating effect of the retained urea, or, in its splitting off, to the carbonate of ammonia.

Toxic.—These ulcers result from poisoning from phosphorus, arsenic, and mercury.

Miscellaneous.—Occasionally ulcers are found in pemphigus, erysipelas, leprosy, septicemia, gout, scurvy, leukemia, amyloid disease; also after acute infectious diseases—yellow fever, diphtheria, smallpox, etc.

Symptoms.—There are no distinctive symptoms for these different varieties. The general symptoms are: (1) Diarrhea. (2) Blood, pus, or shreds of tissue in the feces, especially if in the large intestine. (3) Pain. This may be absent; according to Nothnagel,¹ the absence of pain may be due to two causes—destruction of the nerves by the disease process, or the continual irritation may have exhausted the sensitiveness. (4) Presence of tubercle bacilli in the feces. Dyspepsia and vomiting are rare. (5) The presence of intestinal worms or eggs in the feces.

The chief symptom in the tuberculous variety is diarrhea, and when associated with hemorrhage has the following syndrome: elevation of temperature (usually 103° to 105°), pain, nausea and vomiting, local abdominal sensitiveness, and macroscopic appearance of blood in the stool the following day.

INFECTIVE GRANULOMATA.

(Tuberculosis is treated of elsewhere in the present work.)

Actinomycosis.—This usually develops in the large intestine. Its frequency may be judged from the four hundred and twenty-one cases collected by Illich²: 51.8 per cent., neck; 13.8 per cent., lungs; 21 per cent., abdomen (mostly intestinal); 2.6 per cent., skin; 7 per cent., undetermined.

The organisms may form a thin growth along the mucous surface of the bowel, or the wall throughout may be invaded. The process may perforate into the rectum or the bladder. Lanz³ has set aside the actinomycosis of the vermiform appendix as a special variety—perityphlitis actinomycotica—comprising about one-half of the total number of cases of intestinal actinomycosis. It will be diagnosed as appendicitis until examined by the microscopist as to its true nature.

The symptoms are not very characteristic—attacks of colic, vomiting, and constipation alternating with diarrhea. In the cecal variety there is a perceptible

¹ Nothnagel, H.: "Diseases of the Intestines and Peritoneum." Phila., 1907.

² Illich, A.: Beitrag zur Klinik der Aktinomykose. Wien, 1892.

³ Lanz, Otto: "Ueber crurale Blasenhernie," Correspondenz-Blatt. f. Schweizer Aerzte, 1892, xxii, 709.

swelling. The feces should be carefully examined from day to day for the actinomyces to establish the differential diagnosis.

In a case operated on by the writer several years ago the patient had severe pains in the abdomen, and frequent vomiting, but no diarrhea. The pain and vomiting continued for five days, when the latter subsided, but there remained considerable tenderness in the upper abdomen with extensive induration over the chest margin. A rib was resected and a subcostal abscess cavity drained; the patient gradually sank, and died ten days after the operation.

Necropsy showed an abscess cavity running through the diaphragm on the left side. There was an opening 1 inch long through the great omentum between the transverse colon and stomach, extending down into another abscess cavity.



FIG. 625.—INTUSSUSCEPTION CAUSED BY FIBROID TUMOR OF THE INTESTINE (Hunner's case; drawn from specimen). ($\frac{1}{3}$ Natural size.)

f, Fibroid tumor causing intussusception; b, line of intestinal invagination; c, intussusciens; d, intussusceptum.

The omentum around this cavity was densely, and over its entire surface more sparingly, studded with pale yellow flakes about $\frac{1}{8}$ inch in diameter, much resembling flattened grains of wheat or the plaques of pancreatic fat necrosis. The fatty tissues attached to the colon and its mesentery were considerably infiltrated with similar bodies. The spleen was found floating in the cavity, supported only by its vessels, and showed no signs of infection.

On examining the surface of the stomach and bowels the writer was unable to find an abrasion through which the fungus had escaped from the alimentary canal. Judging from the point at which the greatest destruction had occurred, it would appear that the germs had escaped through the walls of the stomach or duodenum.

Treatment.—The abscesses should be drained as rapidly as they form. Iodid of potash should be given in a systematic manner and the x-ray treatment pushed to a

maximum of toleration. When the disease is confined to the appendix or to a segment of the bowel without perforating its wall, a resection should be made extending far beyond the infiltrated margin.

Syphilis is rare in the small intestine; it attacks principally the large intestine, colon and lower rectum. Ulcers are caused, as a rule, by the breaking down of tertiary deposits. Perforation into the neighboring viscera is common, but an opening into the peritoneum is apparently unknown.

Syphilis is attended by an obstinate diarrhea, which may last for years unless combated by specifics. (The surgical treatment of specific lesions of the rectum is considered under a separate head.)

TUMORS.

Benign tumors comprise adenoma, lipoma, fibroma, myoma, and angioma.

Of these varieties, adenomata are probably the most common. They may occur in any part of the intestines, but are especially frequent in the rectum. They are generally multiple, as many as 10,000 having been counted in a single case (Luschka¹). They may become cancerous.

Lipoma may be single or multiple; they are not common. They sometimes grow from the appendices epiploicæ of the colon.

Fibroma and fibromyoma are very rare. They produce symptoms of obstruction by their size and cause intussusception by traction at point of attachment (Fig. 625).

Myoma are submucous or subserous and occur with about equal frequency, though the former do not grow as large as the subserous type. Both varieties are more frequent in the large bowel. Allchin and Hebb² report a rare case of lymphangiectasis of the intestine. The mucosa of the entire small intestine was beset with myriads of whitish flocculi, not extending into the mucosa proper; no ulcers were found. The process was strictly limited to the small intestine; the stomach and large intestine were free. The patient was a man of thirty-eight with a history of diarrhea for some months before admission.

The symptoms of these benign tumors are few unless they produce obstruction or cause invagination. If multiple, they may give rise to hemorrhage and catarrhal enteritis. The growths are either sessile or pedunculated; if the latter, they appear as "polypi," which sometimes tear loose or slough off. Occasionally they reach such a size that they are palpable through the abdominal wall.

The treatment will, as a rule, be that of obstruction caused by them, with excision of the segment of bowel containing the tumor.

Malignant Growths.—Carcinoma of the small intestine is rare compared with that of the large. It is nearly always primary; secondary growths are uncommon.

¹ Luschka, H.: "Ueber polypöse Vegetationen der gesammten Dickdarmschleimhaut," Virchow's Archiv, 1861, xx, 133.

² Allchin and Hebb: "Lymphangiectasis Intestini," Trans. Path. Soc. of London, 1894-95, xlv, p. 221.

Pyloric cancer occasionally extends to the duodenum. (See Tumors of the Rectum.)

Sarcoma of the intestine is not so common as carcinoma. In the small intestine it is usually high up, the tendency to carcinoma becoming more marked as the cecum is approached. In a case reported by LaRoy 1250 melanosarcomata were discovered. Nearly twice as many men as women are affected, and, as in sarcoma elsewhere, the ages average less than in cancer.

The *symptoms* are few: palpable tumor; frequent elevation of temperature, which confounds it with granuloma; rapid emaciation, since sarcoma grows faster than carcinoma; and occasionally blood in the stools. Stenosis is rare; on the con-



FIG. 626.—ENLARGEMENT OF INTESTINAL LUMEN BY SARCOMA.
a, Lumen; b, thick bowel wall; c, proximal end; d, distal end.

trary, there is usually a considerable dilatation at the site of the tumor, as the sarcoma involves the muscular and fibrous layers and not the mucous.

It many times follows a mild trauma, and must be carefully differentiated from gumma, which it closely resembles clinically and macroscopically. The specific treatment is the best pre-operative diagnostic test.

Treatment is operative only, though the results are not very encouraging, the mortality being 26 per cent., which is somewhat due to the fact that the patients do not apply to the surgeon early enough.

Carcinoma is rarely ever found in the ileum or jejunum. It occurs in the large intestine most frequently at its strictures or flexures, as these points are subjected to mild traumas by fecal stasis and excessive contractions. They occur in the following order of frequency: rectum, sigmoid, cecum, appendix, hepatic flexure, splenic flexure, etc.

Early operative treatment should be resorted to as described fully under

technic. The permanent results are fairly good, as metastasis is late, these structures having only a sparse lymphatic supply.

INTESTINAL REPAIR.

Operations for intestinal repair are performed for:

1. Injuries and perforations, not involving the mesenteric attachment, with destruction of less than one-third of the circumference.
2. Injuries at the mesenteric attachment.

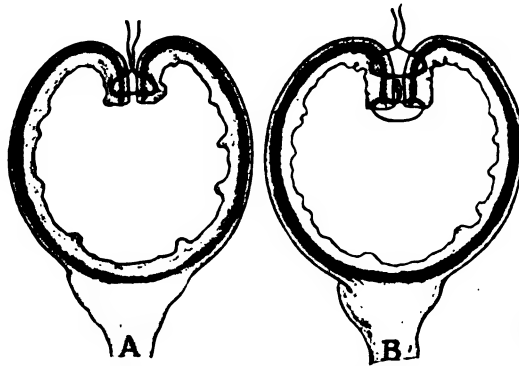


FIG. 627.—INTESTINAL SUTURES.
A, Lembert suture; B, Czerny-Lembert suture.

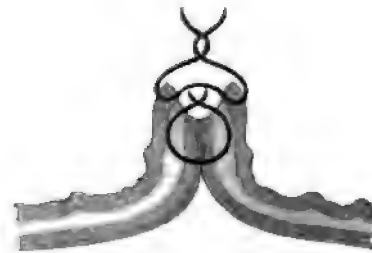


FIG. 628.—WÖLFLE'S DOUBLE ROW OF INTERRUPTED SUTURES.

3. Disease or extensive injury, necessitating resection of the bowel.
- These lesions are repaired by: (a) Suture, either longitudinal or transverse;
(b) resection with end-to-end, side-to-side, or end-to-side anastomosis.

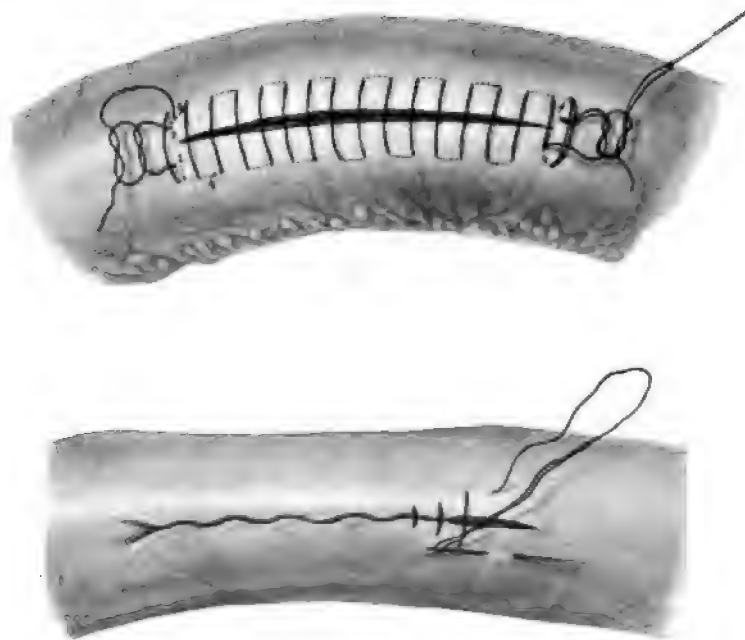


FIG. 629.—CUSHING'S METHOD OF INSERTION OF LEMBERT'S TYPE OF SUTURE.

Lembert¹ occupies a very prominent place in the history of intestinal repair, as his suture is the foundation of the best type of intestinal approximation. His idea of apposition of serous surfaces for the purpose of producing permanent adhesions inaugurated a new era in this branch of surgery. Czerny's² modification was an important step in advance—the approximation of the serous surfaces being supplemented by that of the mucous edges (Czerny-Lembert suture).

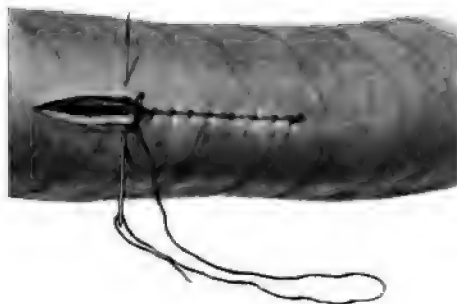


FIG. 630.—DUPUYTREN'S SUTURE, LEMBERT TYPE.

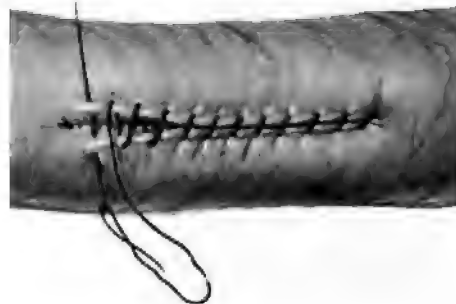


FIG. 631.—DUPUYTREN'S INTESTINAL SUTURE, WITH SECOND ROW OF SUTURES.

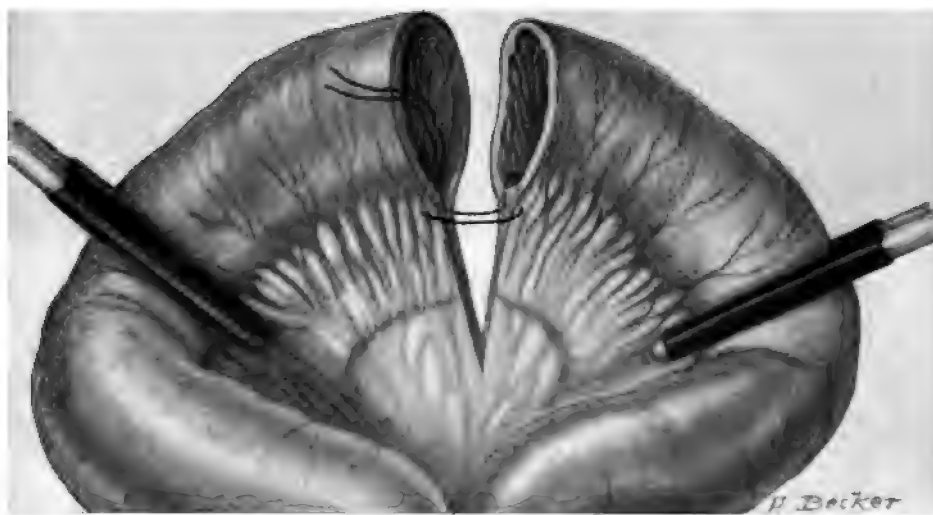


FIG. 632.—CONNELL SUTURE.
Method of applying stitch in mesenteric border

Intestinal approximation may be made by: (a) Suture alone; (b) suture with mechanical aids; (c) mechanical aids only.

Sutures.—The best known and most reliable sutures are the following, and no detailed description is necessary, since the illustrations furnish sufficient information.

The *Lembert* is a suture which passes through the two outer coats of the bowel, so as to approximate the serous surfaces and invert the cut edges (Fig. 627).

¹ Lembert, J. B.: "Rep. Gen. d'Anat. et. de Phy. Path.," 1826, ii, 3.

The *Czerny-Lembert* is a double-row suture; the first (Czerny) or deep series includes all the coats of the bowel; the second (the Lembert), described above, should be placed just outside and close to the Czerny so as to form only a small inversion diaphragm (Fig. 627).

The *Wölfler* is a double row of interrupted sutures (Fig. 628).

The *Halsted*¹ is of the Lembert type; in other words, it is a plain quilt suture passing through the two outer coats and some of the inner.

The *Cushing*² (Fig. 629) is also a continuous suture of the Lembert type.

The *Dupuytren*³ (Fig. 630, 631) is another continuous suture of the Lembert type.

The *Connell*⁴ (Figs. 632, 633, 634, 635, 636) passes through all the coats, and the



FIG. 633.—CONNELL'S SUTURE.
Knots applied within the lumen of bowel; starting the second row.



FIG. 634.—CONNELL'S SUTURE.
Method of inserting needle for tying the last knot.

knots when tied are within the lumen. When understood, this is easily applicable and very effective.

Of all these methods, the Czerny-Lembert is the most practical and easily understood. The errors in its application are: (1) Failure to include the vessels in the edges of the incision and to forcibly compress them; (2) the penetration of the

¹ Halsted, W. S.: "Intestinal Anastomosis," Johns Hopkins Hosp. Bull., 1891, ii, 1.

² Cushing, H. W.: "The 'Right Angle' Continuous Intestinal Suture," Med. and Surg. Rep., Boston City Hosp., 1889, 81.

³ Dupuytren, G.: "Leçons Orales de Clinique Chirurgicale," Paris, 1832-4.

⁴ Connell, F. G.: "The Knot within the Lumen in Intestinal Surgery," Jour. Amer. Med. Assoc., 1901, xxxvii, 2, 952.

mucosa by the needle; (3) failure to accurately approximate the peritoneum at the mesenteric attachment, thus preventing infection by leakage; this is the most vulnerable point in all these methods of approximation; an overstitch should be taken in the mesentery at its attachment to the intestine so as to overlap the divided peritoneal edges; (4) the occasional insertion of the Lembert portion too far from the Czerny portion, thus inverting the bowel in the form of a diaphragm, which tends to contract and ultimately to produce obstruction; (5) the infection along the

Czerny line of approximation leading to failure of union and secondary leakage (this, however, is not as frequent as is generally supposed); (6) the use of unabsorbable material for the Czerny portion gives rise to the production of much cicatricial tissue, which tends to contraction and stenosis; if absorbable, it gives support for a couple of hours and no longer; (7) the infection at the mesenteric attachment or some other portion of the circumference, when virulent, tends to separation of the approximated edges; superficially placed sutures also permit leakage; this



FIG. 635.—CONNELL'S SUTURE.
Thread drawn transversely across, ready for tying.

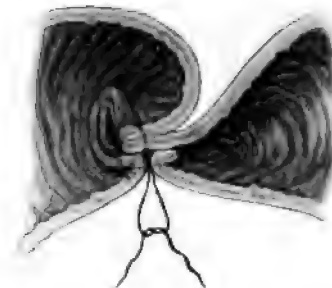


FIG. 636.—CONNELL'S SUTURE.
Latter tied and ready for embedding.

separation is many times erroneously attributed to the type of suture or method employed for the approximation.

The suture material should be of silk or linen, preferably the celluloid-linen (Pagenstecher). An absorbable suture should never be relied on for union of the intestine. Intestinal sutures are safer when there is no capillarity; hence, if silk is used it should be twisted and coated with wax, rubber, or paraffin to destroy its capillary action. This material is not so effective, however, as the celluloid.

When more than one-third of the bowel circumference is involved and resection not indicated, it is better to make an elbow approximation, as a larger lumen will be thereby obtained. This V-shaped kinking (Fig. 637) gradually assumes a

straight position. The elbow approximation is not permissible where the mesentery has been sacrificed, as a gangrene of the convex portion would result.

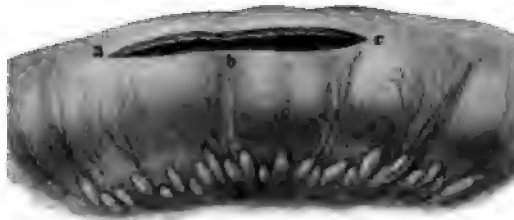


FIG. 637.—METHOD OF ENLARGING BOWEL WHERE CONSTRICTION EXISTS BETWEEN *a* AND *c*. Latter points are approximated, so as to enlarge lumen by elbowing process.

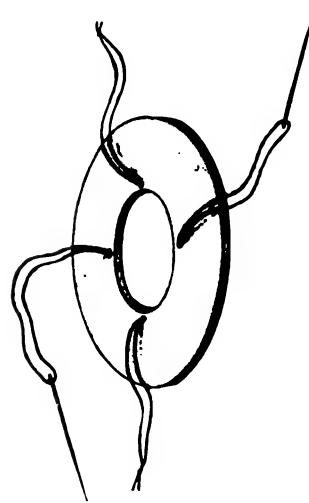


FIG. 638.—SENN'S BONE PLATE WITH THREADS READY FOR INSERTION.



FIG. 639.—COFFEY'S CRUSHABLE POTATO BOBBIN.

Sutures and Mechanical Aids.—Among the mechanical aids which have been used in approximation may be mentioned: Senn's¹ decalcified bone plates (Fig. 638)

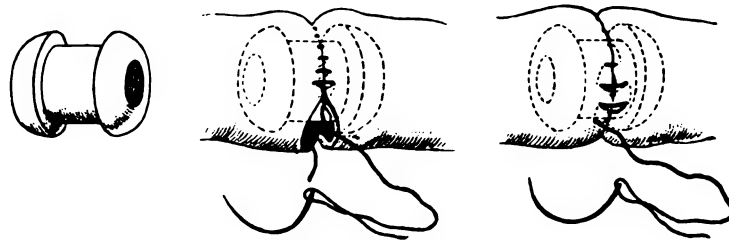


FIG. 640. METHOD OF INSERTION OF SUTURE WITH ROBSON'S BOBBIN AS A MECHANICAL AID.

Landerer's potato bobbin, Coffey's crushable bobbin (Fig. 639), Mayo Robson's²

¹ Senn, N.: Ann. Surg., St. Louis, 1888, vol. vii, p. 1.

² Robson, A. W. Mayo: "A Method of Performing Intestinal Anastomosis by Means of Decalcified Bone Bobbins," Brit. Med. Jour., 1893, i, 688.

bone bobbin (Fig. 640), Allingham's bone bobbin, Harrington's¹ segmented ring, Dawbarn's potato plates (Figs. 641 and 642), Murphy's² button and its modifications, such as those of Hartmann, Kümmell, Jaboulay, Frank, etc.

All of these are so well understood that it is unnecessary to give a detailed description of their application.

In anastomosis by mechanical means we have to consider the end-to-end anastomosis, then the end-to-side, and lastly the side-to-side.

Approximation with the Murphy Button.—Neither the button, its modifications, nor suture should ever be used in

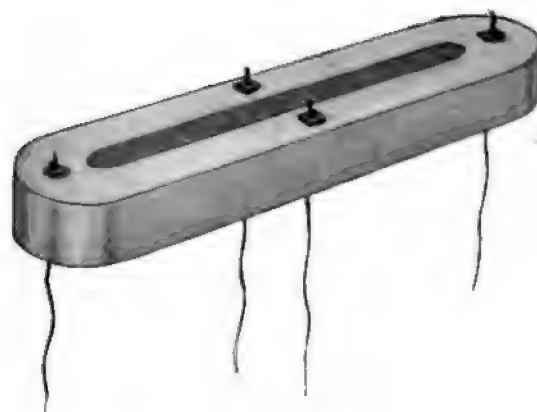


FIG. 641.—DAWBARN'S POTATO PLATE WITH SUTURE INSERTED.

end-to-end anastomosis of the large intestine (except in the rectum or sigmoid) where



FIG. 642.—TECHNIC OF LATERAL ANASTOMOSIS BY DAWBARN'S POTATO PLATE
Same in position. Curved bistoury executing division of clamp septum.

an end-to-side or side-to-side anastomosis is possible, as anatomically too large an area of the bowel circumference is uncovered by peritoneum.

¹ Harrington, F. B.: "Segmented Ring for Intestinal Anastomosis." *Boston Med. and Surg. Jour.*, 1902, cxlvii, 521.

² Murphy, J. B.: "Cholecysto-intestinal. Gastro-intestinal, Entero-intestinal Anastomosis, etc.," *N. Y. Med. Record*, 1892, xlii, 667.

Technic for Resection and End-to-end Anastomosis by the Murphy Button.—
The special instruments necessary are:

Round button No. 3.

Intestinal clamps or forceps (Murphy's intestinal clamp (Fig. 648), LaPlace's or O'Hara's¹ forceps).

Aneurism needle.

Hartmann's lateral button-holder or Cordier's² obturator.

Most of these instruments are well known to every surgeon, except possibly the button-holder. This, as shown in the illustration (Fig. 644), is composed of two long blades joined like an ordinary hemostat, the ends of which terminate in flat semilunar segments with which to grasp the cylinders of the button. I have used these forceps for the past fifteen years, and found them very serviceable, giving full control of the button until the two halves are securely invaginated.

The first step (*a*) is to protect the rest of the viscera from the coil of intestine which is to be prepared for resection. This coil is freed from its contents by pressure, not severe enough, however, to injure the wall of the bowel; (*b*) then one of the

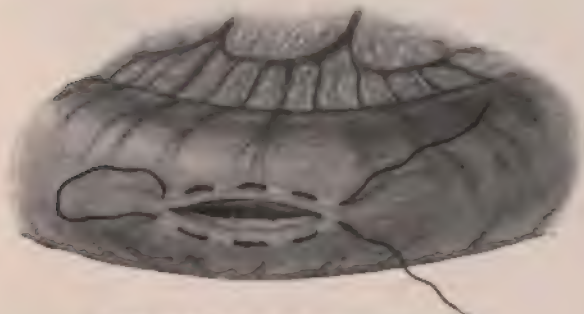


FIG. 643.—TECHNIC OF LATERAL ANASTOMOSIS.
Appearance of puckering-string in lateral anastomosis.



FIG. 644.—HARTMANN'S BUTTON-HOLDER.

intestinal clamps or forceps is applied to the intestine both proximal and distal to the area to be resected. (*c*) LaPlace's forceps is very useful, though for some years past the writer has used Murphy's intestinal clamp, as its simplicity renders it readily serviceable. (*d*) An aneurism needle threaded with catgut, silk, or linen is passed through the mesentery tributary to the zone to be resected, $1\frac{1}{2}$ inches from the intestinal border; care should be taken not to include more of the mesentery

¹ O'Hara, M.: "A Method of Performing Anastomosis of Hollow Viscera by a New Instrument," *Ann. Surg.*, 1901, xxxiii, 179.

² Cordier, A. H.: "Murphy Button Obturator and Applicator," *Jour. Amer. Med. Assoc.*, 1905, xlv, 2, 853.

than is complementary to the area to be excised. (e) The mesentery should be split centrifugally from the ligature to the intestinal border, then two floss needles $2\frac{1}{2}$ inches long, threaded with silk or linen 16 inches long, are used to run the puckering-string. The initial over-stitch is made in the mesenteric border; the needles are then run in and out through the wall on each side of the intestine in the line of intended division to its convex border (Fig. 648). Retaining these needles in the wall as splints, the intestine is divided with a scissors close to the needles—thus avoiding the possibility of cutting the threads. The needles are then drawn through (Fig. 649), the button inserted (Fig. 649), and the puckering-string tied close to its cylinder, care being taken to invert the mucosa. The thread is then divided close to the knot. The other half of the button is inserted in the same

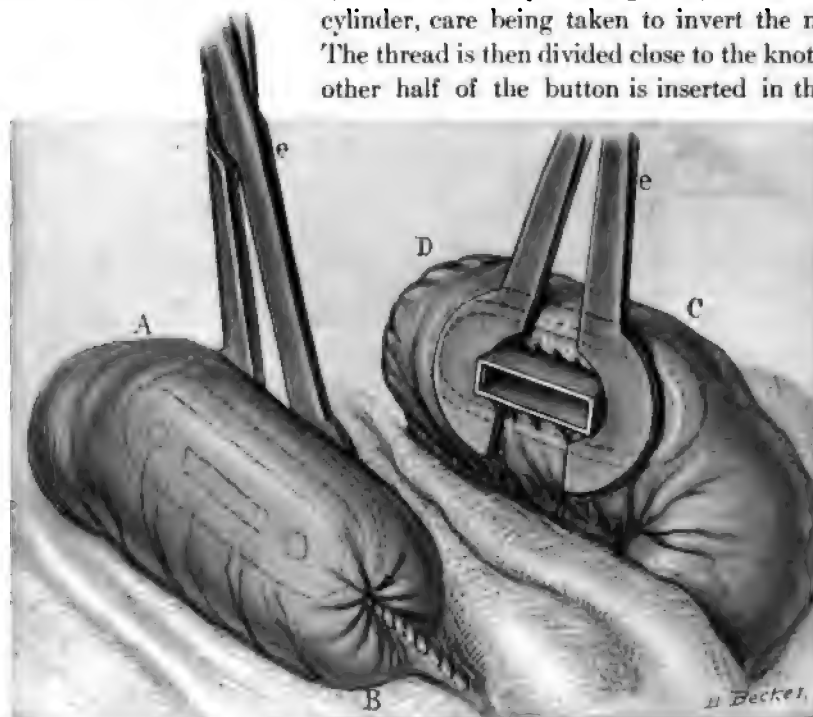


FIG. 645—LATERAL ANASTOMOSIS WITH MURPHY'S OBLONG BUTTON.

A, Proximal portion; B, closure of same; C, distal portion; D, the same closed; e, e, Hartmann's button-holder attached to halves of button.

manner (Fig. 649) and Hartmann's clamps placed on each cylinder to facilitate their approximation. The mesentery is then divided and the segment removed; the two halves of the button are then pressed slowly but forcibly together. (f) The peritoneum and the viscera are protected from the contents of the intestine by an assistant detailed for this purpose.

The supporting suture advocated and used by some operators is entirely superfluous. The lateral and end-to-end approximations are made in the same manner; the convex portion of the bowel should be used for apposition.

The edges of the button exert a constant pressure on the intestinal wall until the pressure necrosis has reached its maximum on the third day. The approximating

edges of the button should be an accurate semicircle, thus bringing the point of greatest pressure in the center of the contact zone, and furnishing a good surface for union outside of the center line of pressure necrosis. In the selection of buttons the operator should note the uniform semicircular surface of the cups and the integrity of the spring catches. It is essential, also, that the margins of the button be constructed so as not to compromise the blood-supply of the bowel edges. The schematic drawing (Fig. 646) shows what I desire to emphasize. (The writer will not give a detailed

description of the technic of insertion of sutures, as the cuts sufficiently illustrate their application.)

In end-to-end approximation, sepsis and subsequent separation occur most frequently at the mesenteric attachment. The explanation for this is that there is no peritoneal covering at this point, consequently primary peritoneal agglutination cannot occur. Secondly, the zone here is exposed to infection, since loose connective tissue and fat are



FIG. 646.—MURPHY'S OBLONG BUTTON AND KEY.

The profile of the approximation surface should be semicircular (a) instead of being flat.



FIG. 647.—SHOWING MANNER IN WHICH BUTTON IS INTRODUCED.

a, Ends of purse-string suture, ready to be tied; b, forceps holding edge of button; c, forceps everting cut edge of intestine to allow introduction of button.

known to have less resistance to microbic invasion than any tissues in the body. Lastly, at this location it is practically impossible to secure a flat lateral surface for approximation.

The failure may be the result of infection at the line of union, either from pre-existing disease or from pre-existing infection, from infiltration of the intestinal wall above the point of obstruction, or fecal retention.

Septic gangrene or ischemia at the junction may also cause failure of union, which may result from: (a) Removal of more of the mesenteric border than of the convex portion of the wall. (b) Including too large a mass of vessels in the suture, thus shutting off the blood-supply. (c) Insufficient resection of the infiltrated area of the intestinal wall, especially on the proximal side of an obstruction.

In the presence of obstruction the infiltration of the wall is so great that the slightest mechanical disturbance will produce necrosis. For this reason, several inches or even feet of the mural infiltration should be resected in order to obtain a good sound tissue for approximation. Many deaths hitherto attributed to the means of approximation are really due to a failure to observe these points. Traction or tension will also endanger the line of union, as the stitches pull out or cut through and permit leakage. Still another cause of failure is tuberculosis of the peritoneum, which retards peritoneal agglutination. Hence resection of the intestine in the presence of tuberculous peritonitis is always hazardous.

The danger from all these causes can be materially lessened by protecting the line of union with omental flaps or grafts. The peritoneum of the omentum favors agglutination and is a source of great protection to the patient. These omental flaps will not only protect the peritoneal cavity from subsequent infection from the

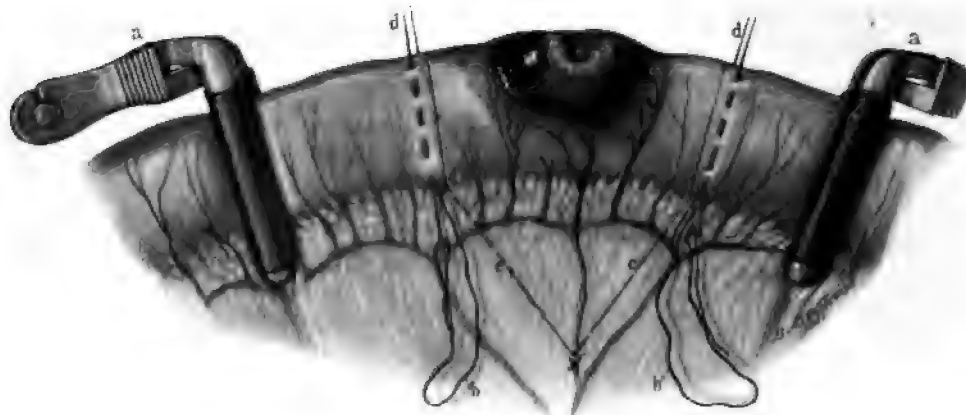


FIG. 648.—TECHNIC OF END-TO-END ANASTOMOSIS.

a, Intestinal clamp on the intestine; b, straight needle threaded with suture intended for puckering suture; c, dotted line to indicate triangular incision in mesentery; d, straight needles acting as splints ready to be pulled out.

intestinal canal, but will increase the vascularization of the line of union, a very important and essential point. If the line of union is well nourished the process of repair has all the guaranty of success necessary.

The *technic of omental grafting* is as follows: A segment of omentum, the size and shape of which are determined by the surgeon, is excised and immediately placed in hot (98.6°) normal salt solution. After a careful scarification has been made on each side of the suture line, the omental graft is placed on a piece of gauze to dry, and is then applied over the line of sutures (care being taken that the center of the graft corresponds to the suture line), and is fixed to the bowel by fine catgut sutures (Fig. 650). Firm agglutination between the graft and the intestine forms in a few hours. It is easier to apply these flaps when they are not detached from the omentum, but are slid over.

End-to-side Approximation.—In many cases, especially when enteric exclusion

is desired, an end-to-side anastomosis may be indicated. This may be accomplished either with suture or with the round button (Fig. 647); the oblong button cannot be used. This variety of approximation offers no especial difficulties except when segments of intestine of unequal size have to be united, in which event Maunsell's¹ method of suture gives very good results.



FIG. 649.—END-TO-END ANASTOMOSIS (Murphy's method).

a, Intestinal clamps placed on the intestine; b, forceps grasping the edge of one half; c, purse-string suture passed around the neck of the button, ready to be tied.

Side-to-side Anastomosis.—This variety is contraindicated in the small intestine, except where the ends vary greatly in size or where the Maunsell method is difficult or impracticable. It is a common and useful way of joining the small to the large bowel. It is the most favorable method, so far as securing immediate union is concerned, since the entire circumference of the anastomotic opening is surrounded by peritoneum. The local irritation will cause a rapid formation of plastic exudate over the line of union, and in this way the latter will be protected. More-



FIG. 650.—OMENTAL GRAFT. SENN'S METHOD.
Line of suture covered with a flap of omentum.

¹ Maunsell, H. W.: "A New Method of Excising the Two Upper Portions of the Rectum and the Lower Segment of the Sigmoid Flexure of the Colon," *London Lancet*, 1892, ii, 473.

over, the sealing of the suture-line is so perfect that invasion of micro-organisms is almost impossible.

Technic.—The ends are closed by Czerny-Lembert sutures, or by crushing them in an angiotribe, and after removing the instrument the end is ligated with a puckering string tied in the crease left by the instrument (Fig. 652). The mucosa on the distal side of the ligature is then removed, and the stump embedded as in appendectomy with a puckering string of Lembert sutures (Fig. 653). After the ends are closed the sides may be brought together with double rows of continued sutures, using stay-loops at either end of the line of union. The aperture of communication should not be less than 1 inch nor more than $1\frac{1}{2}$ inches. It was feared at one time that the line of union would contract and produce stenosis; experience, however,

has shown this rarely happens.

As in end-to-end approximation, the bowel should be carefully clamped to exclude the feces from the field of operation. If the button is used, the oblong one should be chosen. Two straight needles threaded with linen are passed through the wall of each segment of bowel. As soon as the needles are in place the bowel wall is incised between them.

It has always been my practice to make this incision while the

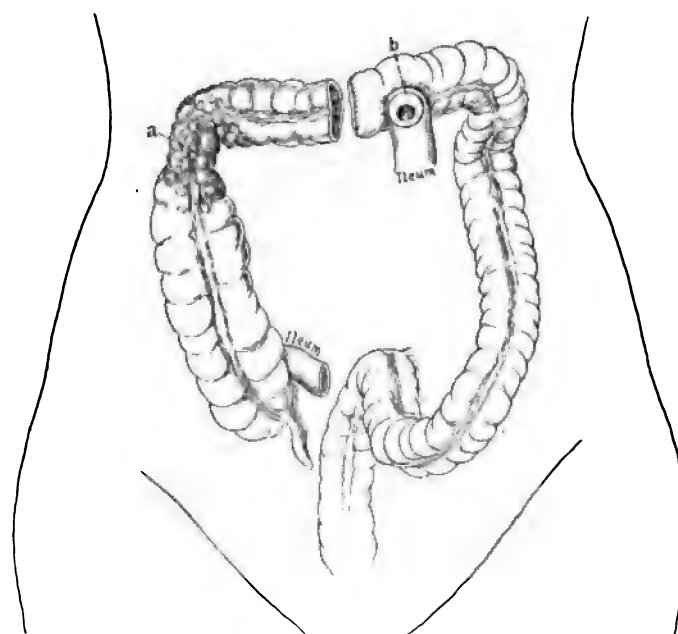


FIG. 651.—TECHNIC IN END-TO-SIDE ANASTOMOSIS BY MURPHY'S ROUND BUTTON.

a, Cecum; b, button.

needles are still in place, as they serve as splints and facilitate the cutting, after which the needles are drawn through. When this is accomplished, the halves of the button are inserted, the ligatures tied, Hartmann's holders applied on the cylinders, and the button pressed together. The bowel must be so connected that the peristaltic waves of the proximal and distal segments are in the same direction.

The use of the button shortens the time of the operation and furnishes a uniform line of approximation. When the pressure necrosis is complete, which, as stated above, occurs on the third day, we have similar histologic structures in edge-to-edge apposition, which is ideal, as a union of similar histologic structures requires the least amount of connective tissue (the least scar tissue). It is a little out of fashion

now to admit that mechanic aids are of material assistance in intestinal approximation, but all one has to do to convince himself of the serviceable purpose of these aids to suture, is to visit a number of operating rooms and observe the irregularity and imperfection of suture approximations even in skilled hands. The results in Czerny's clinic show that failures attributed to various sutures, as those of Moynihan, Cushing, Connell, Mayo, or to the button are due not so much to the use of one or the other method, as to their inaccurate application, the failure to recognize pathologic conditions inimical to their application or to regional infection during the operation. No man can perform well an intestinal approximation by any method without first familiarizing himself with its detailed technic in practical application. There is no method too simple for the conscientious operator.

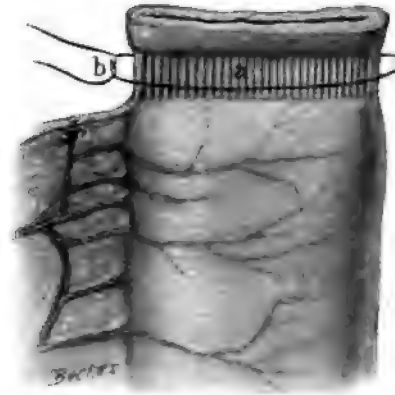


FIG. 652.—TECHNIC OF LATERAL ANASTOMOSIS.
a, Depression produced by angiotribe; b, point of ligation.

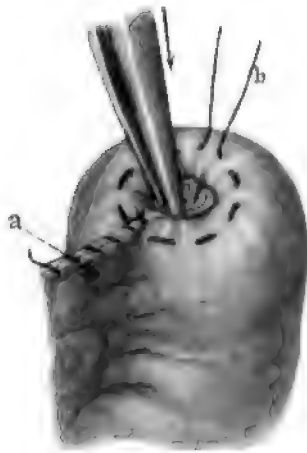


FIG. 653.—TECHNIC OF LATERAL ANASTOMOSIS.

a, Method of overstretching mesentery; b, Lembert puckering stitch invaginating stump.

Objection has been made (1) by some who have had little or no experience with mechanical aids, and (2) by those who have had little experience with any technic of intestinal approximation; their opinions should therefore have but little weight. A large percentage of expert operators make use of the button in complicated cases, and it forms a ubiquitous part of their armamentarium. This we interpret as meaning that its application is easier and more readily accomplished than the suture. For the occasional operator and those of little experience it is by far the simplest and safest method of approximation. The conscientious critic of technic and methods is searching for a means of obtaining ideal results under diverse and uncontrollable pathologic conditions. Kocher, the technical artist of the profession, remarks: "I use the button for lateral approximation because it is so simple."

Approximation of the Intestine in Fixed Zones.

—This may require the application of any of the methods heretofore described. Hence the surgeon must be familiar with all of them, as the occasions for

their application occur at times most inopportune for securing information.

The danger of post-operative stenosis depends on: (1) Segment of intestine involved; (2) amount of connective tissue excited by the union.

The greatest tendency to stenosis is in the rectum, next in the sigmoid; the least in the jejunum, next in the ileum; the first is a fixed, the second a movable organ. Unused artificial communications have a tendency to contract, but rarely to the extent of closure. The idea that a complete closure of unnecessary anastomotic openings by restoration of normal tracts would take place, has been disproved by an overwhelming number of recent observations; *i. e.*, if complete closure occurs, it is due to other etiologic factors than disuse.

The extent of intestine resected that is compatible with health and life may be estimated from the following cases: Trzebicky¹ has collected nine cases of extensive resection in man varying from 39½ to 89 inches. Of these cases, five recovered, including Kocher's case, in which 82½ inches were resected, and Koeberlé's² of 81 inches. J. F. Mitchell, of the Johns Hopkins Hospital, resected 9 feet of bowel for embolism of the mesenteric artery. H. R. Morton,³ of Riverside, Cal., resected 10 feet 6 inches of the small intestine for a myxosarcoma; the patient recovered. V. Pauchet⁴ removed 13 feet of small intestine and the patient recovered.

Enteric Exclusion.—By this we mean the exclusion of a segment of the intestine from the fecal circuit, though the segment itself is not removed from the abdominal cavity. Enteric exclusion may be either partial (unilateral) or complete (bilateral).

Resection of the intestine is more dangerous than exclusion. If the bowel contents penetrate the lumen of a coil closed at one end only, the peristaltic and antiperistaltic movements force them back into the rest of the canal. If the excluded segment is again reinstated to the fecal tract, its function and size are restored; otherwise it undergoes atrophy.

Partial or Unilateral Enteric Exclusion.—This is accomplished by dividing the intestine, closing up the proximal portion of the distal end, and implanting the distal end of the proximal portion into the intestine below the point of disease or fistula. Occasionally, feces regurgitate into the excluded loop, which is of no particular moment, as they are again expelled. The approximation can be best made with the round button in end-to-side anastomosis, or with the oblong button in side-to-side union. It can be performed quickly, and in the presence of tuberculous lesions and multiple fistulæ with extensive adhesions is a life-saving procedure.

Complete or Bilateral Enteric Exclusion.—This procedure, first practised by Trendelenburg in 1880 for inoperable carcinoma of the cecum, with fatal result, consists in excluding a segment of intestine by closing both ends of the excluded portion. When the operation is performed for fistula or tuberculosis, both ends of the segment are shut off from the rest of the bowel; the ends may be inverted and closed. When there is no fistula, one end is brought out on the surface and sutured to the skin; this opening is maintained as a drain. Although the discharge dimin-

¹ Trzebicky, R.: "Ueber die Grenzen der Zulässigkeit der Dünndarmresektion," *Arch. f. klin. Chir.*, 1894, xlviii, 54.

² Koeberlé, E.: "Résection de deux mètres d'intestin grêle suivie de guérison," *Bull. et Mém. Soc. de Chir.*, 1881, vii, 99.

³ Morton: Personal communication to author.

⁴ Pauchet, V.: "Résection de 4 mètres d'intestin grêle," *Gaz. d. Hôpitaux*, 1905, lxxviii, 1667.

ishes rapidly and atrophy of the segment takes place, it is never complete enough to permit closure of the fistula. After the inflammatory conditions have subsided and the surrounding infiltration has disappeared, during which time the patient may have sufficiently recuperated, the diseased portion may be excised with but little danger. In all pelvic operations in which the intestine has been opened, drainage by either the suprapubic or the vaginal route should be instituted. Infection is the rule, and unless drainage is maintained there is danger not only to the line of union, but to the life of the patient as well. The number of inches of intestine which may be excluded varies greatly. In general, as many inches may be excluded as may be excised.

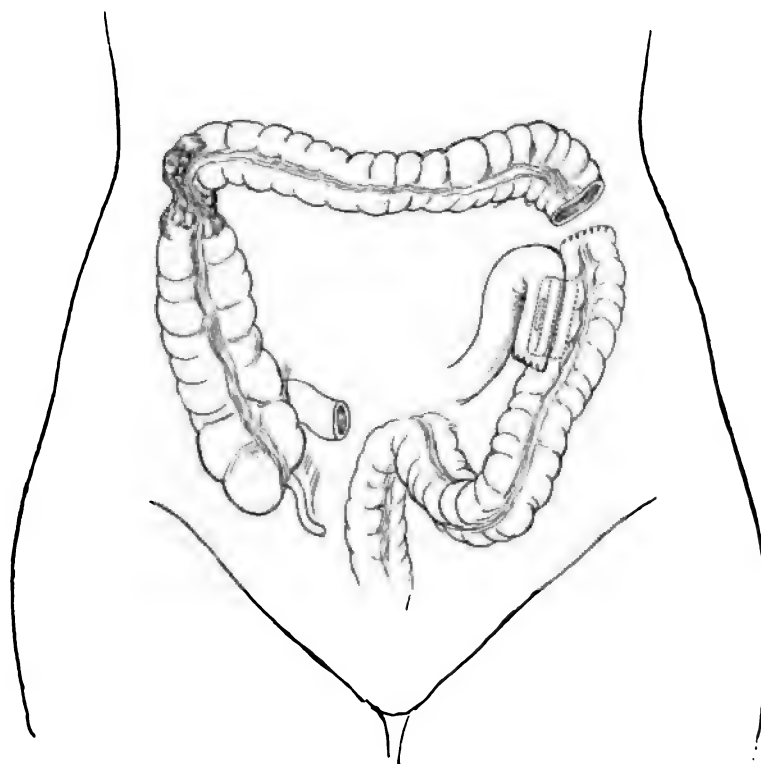


FIG. 654. SIDE-TO-SIDE APPROXIMATION OF ILEUM TO DESCENDING COLON WITH OBLONG MURPHY BUTTON.

The technic of these operations is the same as in end-to-end and side-to-side approximations, and needs no detailed description.

Artificial Anus; Fecal Fistula.—An artificial fecal fistula is made by bringing a loop of the small bowel into the abdominal wall, and is done either to relieve distention or to allow the introduction of nourishment.

Kocher's¹ method is to make an incision $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches above Poupart's ligament, parallel to the epigastric artery; the tissues are incised down to the peritoneum; the distended loop is then brought into the abdominal wound and

¹ Kocher, Th.: "Operative Surgery," New York, 1894.

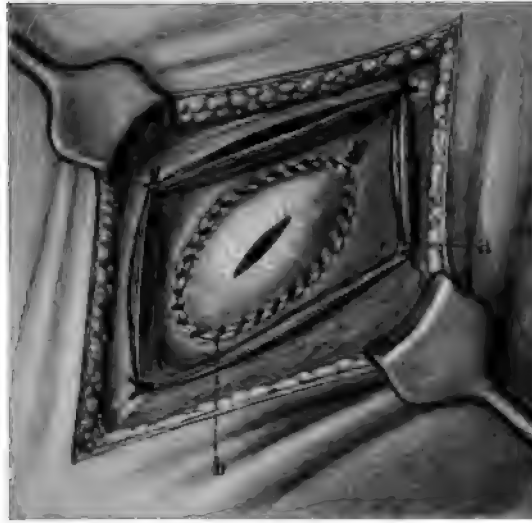


FIG. 655.—TECHNIC OF COLOSTOMY FOR FECAL FISTULA (after Kocher).

a, Reflected peritoneum; b, catgut passed through wall of bowel.

two silkworm-gut sutures passed through all the tissues of the bowel, including the serosa; the latter is then fixed to the peritoneum by a continuous suture. A second catgut suture unites the skin and the seromuscular coats of the bowel. The bowel is then opened, either immediately or in a few days, when adhesions have taken place.

An artificial anus or colostomy is an opening into the large intestine for the purpose of prolonging life, especially in obstruction from malignant disease, and occasionally to divert the current temporarily for the aseptic repair of the bowel further down. Lumbar colostomy was the method used

formerly, but today this is supplanted by the inguinal or abdominal methods. The



FIG. 656.—TECHNIC OF INGUINAL COLOSTOMY.

a, Line of suture of parietal peritoneum to intestinal serosa; b, gauze passed under loop of colon.

operation is attended by little danger. Allingham¹ performed inguinal colostomy

¹ Allingham, W. and H. W.: "Diseases of the Rectum," London, 1901.

sixty-eight times with only two deaths; Cripps¹ had one hundred and forty-three cases with sixteen deaths; and Edwards sixteen cases with one death. Strauss' statistics show a mortality of less than 2 per cent.

Technic of Inguinal or Iliac Colostomy (Fig. 656).—Cover the entire field of

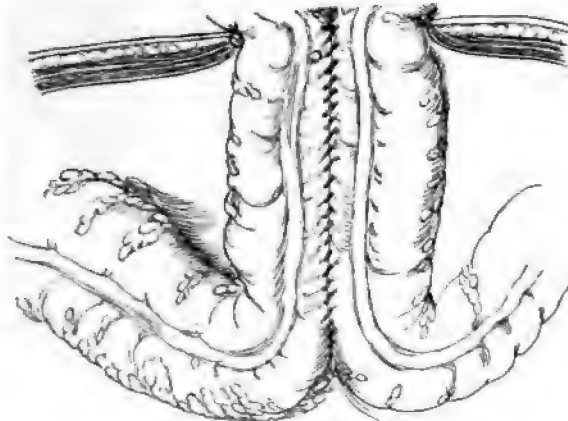


FIG. 657.—TECHNIC OF COLOSTOMY BY BODINE'S METHOD (Bryant).
Line of suture preparatory to the application of Grant's clamp.

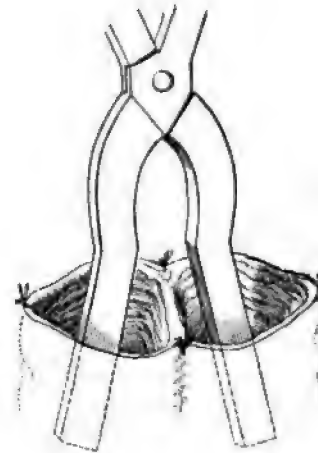


FIG. 658.—TECHNIC OF BODINE'S COLOSTOMY (Bryant).
Method of application of Grant's enterotome.

operation with the adhesive rubber dam, 8 inches square (this can be kept on for many weeks, preventing irritation of the skin). An incision is made 2 inches above Poupart's ligament, through the skin, adipose tissue, and fascia; then the fibers of the external oblique, the transversalis, and the internal oblique are separated parallel to their long axes by blunt dissection, and the peritoneum is incised. The finger is then passed down to the iliac vessels and hooks up the large intestine. The colon is now drawn down as far as possible. The mesocolon is then split at its junction with the bowel, and a glass rod, rubber tube, or gauze passed through the opening. The intestine is now secured in the abdominal wound by interrupted sutures passing through the seromuscular layers of the bowel and parietal peritoneum, and the peritoneum and muscles are united by sutures through the slit in the mesentery permanently, preventing the bowel from dropping back into the abdomen. The bowel may be opened in two or three days, thus establishing the artificial anus.

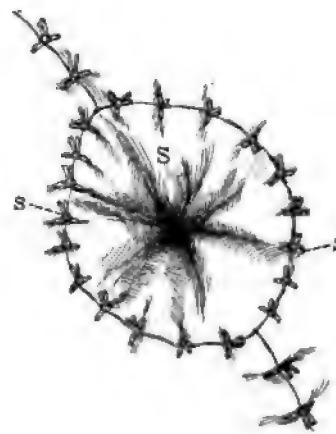


FIG. 659.—TECHNIC OF LUMBAR COLOSTOMY.
S, Sigmoid sutured to skin; s, line of suture.

¹ Cripps, H.: "Diseases of the Rectum and Anus," London, 1907.

If obstruction is present at the time of operation, the bowel must be opened at once, and its edge accurately sutured to the skin with horsehair.

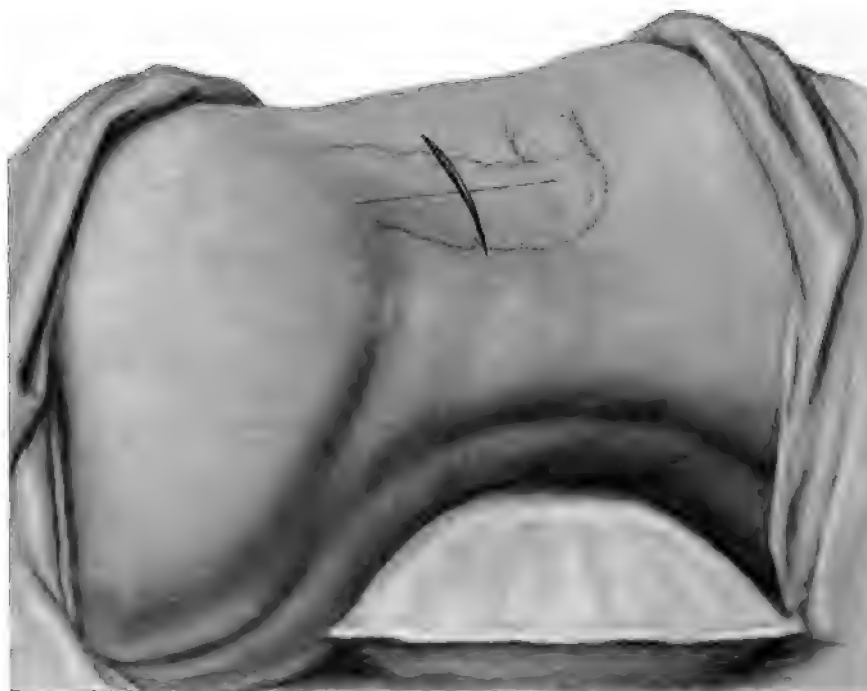


FIG. 660.—TECHNIC OF LUMBAR COLOSTOMY.
Line of incision.

*Bodine's*¹ Method (Figs. 657 and 658).—The abdominal wall is opened as above; the peritoneum is split and its edges secured from retraction. A long loop of

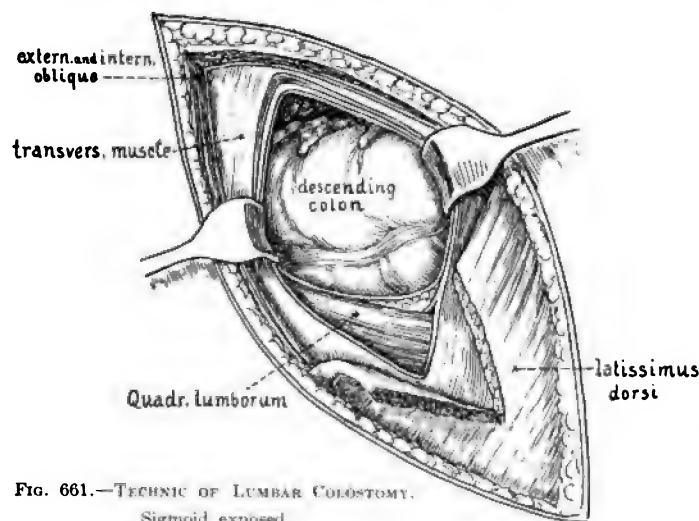


FIG. 661.—TECHNIC OF LUMBAR COLOSTOMY.
Sigmoid exposed.

large intestine is drawn out through the opening and the serosa of the distal and proximal ends is sutured laterally for a distance of about 6 inches. The bowel is then returned to the abdomen, leaving only a small segment outside the wound. This is stitched accurately

¹ Bodine: (quoted) in Bryant's "Operative Surgery," New York, 1905.

to the wound margins with horsehair and opened at once. If it is desired to close the opening later on, the spur may be removed by Grant's enterotome and the bowel and outer opening sutured.

Cripps' Method.—The incision is very short and is on a level with the umbilicus; the peritoneum in this method is stitched to the skin by several interrupted sutures; a loop of large bowel is then drawn out, two-thirds of its circumference being above the level of the incision. The bowel is now sutured to the peritoneum and skin, the sutures through the lower lip of the wound being passed through the inferior longitudinal band, those of the upper lip through the muscularis and near the attachment of the mesentery.

Lumbar colostomy (Figs. 659, 660, 661), as stated before, is seldom practised at present; when performed at all, it is on the left side. An oblique incision 3 inches long is made parallel to the crest of the ilium and down to the aponeurosis. It is very important to avoid injuring the twelfth intercostal nerve, the large trunk of which appears very conspicuous in the wound. The peritoneum is opened from behind, a loop of bowel is grasped or hooked up, and after being stitched to the peritoneum and opened, its divided edge is accurately secured to the skin. The subsequent closure of all types of artificial anus should be made after the plan of closure of intestinal fistulæ, described later. The Dupuytren clamp and all methods requiring its principle are hazardous.

FISTULÆ.

Fistulæ between the gastro-intestinal canal and the genito-urinary tract are not uncommon in gynecologic surgery.

Nephro-enteric Fistula.—The most common form of communication between the kidney and the intestinal tract is that with the ascending or descending colon (Fig. 662).

Etiology.—Renal infections may penetrate through the anterior surface of the kidney or the pelvis of the latter in the direction of the peritoneal cavity. Perinephric abscesses may open into the kidney and also into the colon. Tuberculosis and malignant growths of the kidney after they extend to the capsule of the organ may communicate with the colon. Calculus is by far the most common cause. The mere presence of a calculus does not cause a fistula unless there is pressure exerted on the organ; the size is a lesser etiologic factor than the accompanying infection which necrotizes the tissues. On the other hand, the pathologic condition may originate in the intestine, especially as a tuberculosis. Cysts of the kidney may rupture into the intestine; Küster¹ has collected one hundred

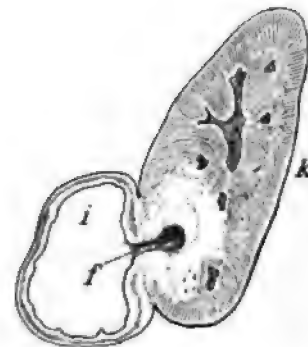


FIG. 662.—NEPHRO-ENTERIC FISTULA.
i, Intestine; k, kidney substance; f, fistula.

¹ Küster, Ernst: "Die Chirurgie der Nieren, der Harnleiter und der Nebennieren," Deutsche Chirurgie, 1896-1902, Lief. 52 b.

and fifty-three cases of this character. (The symptoms, diagnosis, and treatment will appear later.)

Pyelo-enteric or Uretero-enteric Fistula.—A communication between the pelvis of the kidney and the bowel may be either direct or indirect (Figs. 663, 664). The recorded cases are few in number; Hilgenreiner¹ was able to collect only twenty-two.

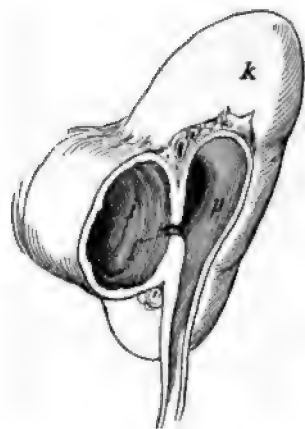


FIG. 663.—PYELO-ENTERIC FISTULA.
i, Intestine; p, pelvis of kidney; k, kidney proper; f, fistulous tract.

Etiology.—Pyelitis, tuberculosis with pyelonephrosis, perinephric abscess. The colon is the most common seat. A communication with the duodenum is rare, and with the other parts of the small intestine still more so. According to Lieblein and Hilgenreiner,² the fistulae were located in the colon thirteen times; three in the duodenum, and only one in the ileum. In a case reported by Murchison,³ a tuberculous infection of the left kidney perforated into the descending colon and also into the stomach at the cardia. In case of pyelo-enteric fistula the kidney is enlarged and becomes adherent to the contiguous segment of intestine.

The parenchyma of the organ is destroyed and the intestinal mucosa becomes greatly changed in character by the irritation of the urine.

Symptoms.—Before the patient becomes aware of the true condition he complains of either bladder or bowel trouble. Careful observations by him may have shown pus in the feces. If the communication is below the third portion of the duodenum, there is no vomiting, as a rule. If, however, it involves the first or second portions, the patient may have regurgitation of urine, feces, or pus (Champaignac⁴). The feces have the odor of ammonia and the urine that of sulphuretted hydrogen. Examination of the urine reveals the presence of urea, uric acid, and, occasionally, casts. While urea and uric acid may be found in the feces in small quantities, acid salts (uric acid and urates) must lead one to suspect fistula, since we know the salts of the feces (phosphates) are alkaline.

Diagnosis may be made on the strength of the above-mentioned symptoms, in addition to which a history of pain or lumbar tumor may be elicited. Cystoscopic examination will also aid materially in the diagnosis. A dish of berries containing small seeds is a very

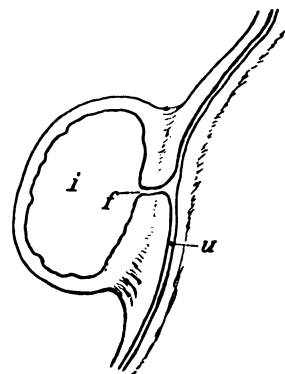


FIG. 664.—URETERO-ENTERIC FISTULA.

i, Intestine; u, ureter; f, fistula.

¹ Lieblein und Hilgenreiner: "Die Geschwüre und die erworbenen Fisteln des Magen-Darmkanals." Deutsche Chirurgie, 1905. Lief. 46C.

² Lieblein and Hilgenreiner: Loc. cit.

³ Murchison: Quoted by Lieblein.

⁴ Champaignac: Quoted by Lieblein.

efficient test, as the seeds will pass through small openings into the urinary tract which would not admit gas or feces.

Prognosis.—This is grave. The patients gradually lose strength from the chronic diarrhea, and succumb from inanition within a few months to a year or two. Very few of them live over five years, although Mikulicz¹ saw one of ten years' and Keen² one (enterovesical) of twenty years' standing.

Treatment.—In nephro-enteric fistulæ, with the exception of the tuberculous type, the operation will consist of some of the extraperitoneal procedures. The technic will be the same as that for abdominal operations in general. Where one kidney is seriously involved from a pathologic standpoint, the best course to pursue is removal, provided the other one has a urea sufficiency.

In pyelo-uretero-intestinal fistula the leaking ureter should be reached by the extraperitoneal route and separated from the intestine. The pus cavity between the ureter and the intestine must be excised or drained. After drainage is kept up for some time, the infiltrated zone contracts and may permit excision of the diseased portion of the ureter, and end-to-end implantation. The kidney should be preserved if possible, since the ureter has great recuperative power. Suture of the ureter in the zone of infiltration is impracticable. Healing of the ureter may be obtained by separating the adhesions between it and the intestine, with subsequent drainage of the abscess cavity. As far as the intestine is concerned, the same rule governs all intestinal fistulæ—first, free the adhesions, and then close the opening by double Lembert sutures.

Removal of the kidney should not be resorted to until it has been established that a restoration of the ureter is impossible, and never until it is established beyond all doubt that the other kidney is physiologically equivalent. It is desirable, before proceeding to the operation, to introduce a stilet-ureteral catheter through the bladder. If the fistula is accompanied by symptoms of renal infection, the first step is to provide drainage so as to save it from the destructive effects of the accumulated pus. Intestinal implantation of the ureter can be easily accomplished technically (Martin), but the ultimate effects on the kidney are disastrous owing to an ascending pyelitis. Mathes in 1897 collected twenty-five cases of implantation of the ureter in this manner with seven deaths.

The end of the ureter may be turned out and attached to the skin, establishing a permanent urinary fistula, with little if any danger to life. Extirpation of a normally secreting kidney under these circumstances should never be resorted to, as it involves a mortality of 30 per cent., while a kidney in which a functional capacity has been gradually destroyed or greatly reduced involves a nephrectomy mortality of less than 3 per cent. Expressed as a law: *The greater the destruction of the functional capacity of the kidney, the less the danger of nephrectomy.*

Among the most important etiologic factors are pelvic infection, post-abortive or post-parturient in origin; neoplasms of the intestine or bladder; tuberculous enteritis, peritonitis, or cystitis; vesical calculus. I recently had a pelvic infection in

¹ Mikulicz, J.: Quoted by Lieblein.

² Keen, W. W.: Quoted by Hilgenreiner.

which fourteen intestinal fistulæ communicated with a common bladder atrium. I had another case in which a carcinoma of the sigmoid led through two openings into the bladder. In both cases I resected the diseased intestine and contiguous bladder wall and the patients made good recoveries. Trauma during parturition; pelvic and abdominal operations; foreign bodies in the bladder and intestine, and abdominal contusions may also be responsible for perforations. A case is recorded in which a needle penetrated the appendix, the latter became adherent to the bladder, and finally the latter was perforated. Post-operative fistulæ are not uncommon, especially between the rectum and the bladder. In pathologic fistulæ the disease may originate primarily in the bladder or intestine, or may follow infection of the surrounding tissue. The initial lesion is most frequent in the intestine.

Enterovesical Fistulæ.—In the cases of enterovesical fistulæ collected by Pascal in his monograph, the cecum and appendix were involved in seventeen, the rectum in nine, and the small intestine in eight. Apphun collected twenty-six cases of fistula between the appendix and the bladder. The morbid conditions of the bowel responsible were: chronic diarrhea in 4; toxic enteritis, typhoid perforation, perforation of Meckel's diverticulum, and tuberculosis of the intestine, each one (Pascal). Among the diseases of surrounding organs or tissues, may be mentioned pelvic peritonitis, salpingitis, tuberculous and malignant conditions of the pelvic organs.

Heine, of Dresden, analyzed 400 cases of fistulæ between the bladder and bowel. Of these, only 8 (2 per cent.) originated from a diverticulum of the intestine. These diverticula may be either congenital or acquired. The latter variety results from inflammatory processes either of the bladder, the intestine, or of the tissues between, with subsequent plastic exudate and final adhesion and traction. This may take place between the intestine and bladder, intestine and vagina, etc. The bladder being a more fixed organ, it can readily be seen that adhesions between it and the intestine, especially to a distant coil, will cause traction on the wall of the intestine, and result in the formation of a false diverticulum. The wall of the latter is thinner than that of the bowel, and as a result of inflammation and adhesion, perforation may occur. The infiltration which occurs in the diverticulum and the surrounding tissue may simulate malignant disease and thus mislead the surgeon. This is particularly true in the sigmoid zone.

Pathologic Anatomy.—These fistulæ are usually located in the posterior wall of the bladder in the vicinity of the trigone. This is more uniformly the case when the communication is between the rectum and the bladder. When it is between the bladder and the large or small intestine, the opening is commonly on the side. The fistulous opening is seldom or never on the anterior surface of the bladder. Of the one hundred and five cases collected by Pascal, in four the opening was in the colon and sigmoid; in sixteen in the appendix and cecum; in twenty-eight in the small intestine, while in the remainder the openings were either multiple or so situated they could not well be classified. When the enterovesical fistula is due to a diverticulum, the opening in 87 per cent. is in the sigmoid.

Symptoms.—The three pathognomonic symptoms are pneumaturia, fecaluria, and pyuria. There may be, in addition, pain in the suprapubic and lumbosacral regions, either independent or concomitant. In the later stages the constant irritation may give rise to additional symptoms, as, for instance, hematuria. As the duration of the disease decreases, the patient becomes emaciated, especially when the fistula is the result of malignant disease.

Occasionally even the classic symptoms may be misleading. Pneumaturia, for instance, may occur after the performance of lithotripsy or on the opening of an abscess due to gas-producing bacilli. In diabetes if the patient is catheterized with instruments not perfectly clean, yeast cells may be introduced which split the sugar into alcohol and carbonic acid, thus giving rise to temporary pneumaturia.

While the examination of the urine is of primary importance for establishment of the diagnosis, it must not be forgotten that residual urine may become alkaline, so when the urine suspected of containing feces is tested, it will be alkaline and may mislead one. When the opening is between the rectum and the bladder, proctæal combined with cystoscopic examination will readily establish the diagnosis. Patent urachus and vesical diverticula must not be mistaken for enteric fistulæ. The best means of establishing the diagnosis of a communication between the bladder and the intestine is the "strawberry diet-test," as the seeds pass into the bladder.

Prognosis.—This is generally unfavorable. Spontaneous healing is rare, even in non-malignant cases. There was a mortality of 8 per cent. in the series collected by Lieblein and only five cases of spontaneous cure.

Treatment may be prophylactic or radical. Inspection of the bladder, intestine, or the tissues contiguous to these organs should be timely. When the history is obscure or there is absence of evidence of acute inflammatory conditions, the possibility of syphilis may be borne in mind. In Kuthe's case the fistula was of specific origin, and appropriate treatment led to its cure.

Radical Treatment.—Colostomy is one of the oldest methods. It is performed in the usual way so as to prevent the feces from entering the fistulous opening; it is an unsatisfactory substitute.

In exclusion of the fistulous zone of the intestine, unilateral and bilateral, the former has not given good results, as feces continue to gain access to the bladder, and urine to the bowel. The bilateral method when a small zone is shut off is successful, though it often requires a second operation for excision.

Suture of vesical fistula:

- (a) Through vesicovaginal route (Simon¹).
- (b) Transvesical (LeDentu²).
- (c) Symphysis route (Langenbuch). A Y-shaped incision is made in such a manner as to have the vertical branch of the Y along the linea alba and the arms on either side of the pubes; the latter may or may not be resected.
- (d) Meehan's incision, in which the bladder is reached by a lateral incision

¹ Simon, G.: "Operation der Blasenscheidenfistel," *Wien. med. Woch.*, 1876, xxvi, 692.

² LeDentu, A.: "Affections chirurgicales des reins et des uréters," Paris, 1889.

along the pubis and temporary resection of the same, giving access to the bladder by the extraperitoneal route.

(e) The perineal, sacral, and rectal routes are advisable for rectovesical fistulæ only.

All these procedures are of some importance from a historic standpoint, but they cannot be applied safely and practically today, therefore the writer advocates the transperitoneal method. The rule governing all enteric fistulæ applies with equal force to the enterovesical type. The first step is separation of all adhesions in close proximity to the communicating canal. After these are freed sufficiently to allow lifting up of the intestine and bladder, the fistula may be opened and clamped so as to prevent leakage into the peritoneal cavity; it must be examined, and if it in-

volves more than 50 per cent. of the circumference of the intestine, a transverse line of suture is preferable to the longitudinal. In suturing a large opening by this transverse method great care should be exercised at the mesenteric border, as this is the danger-point in all methods of intestinal approximation. A double Lembert whip-stitch or over-and-over stitch gives the best results in repair of intestinal fistula, as there is con-



FIG. 665.—TECHNIC OF REPAIR OF ENTEROVESICAL FISTULÆ.
Gastrectomy clamps applied; double row of continuous mural sutures.

siderable mural infiltration in these cases. If the infiltration of the intestinal wall is such that accurate suturing cannot be done without great tension or kinking, a resection should be made, with subsequent approximation with the round button or suture. If, as occasionally happens, the intestinal wall on the proximal side of the fistula is impaired from the resultant obstruction, an end-to-end approximation should not be attempted, but the side-to-side method with oblong button or suture resorted to. This line of suture should always be on the convex border of the bowel, never on the mesenteric.

The most frequent cause of failure in the repair of intestinal fistula is the fact that the intestine is not sufficiently liberated from its adhesions to the neighboring structures. The bladder opening is fixed by gastrectomy clamps (Mayo's or Bernays')

(Figs. 665, 666). The infiltrated zone of the bladder wall around the fistula is dissected out completely, and an accurate very close suture made of all the coats down to the mucosa. The continuous stitch is the best, and "fifteen-day catgut" the safest material to use. A second row of sutures (Lembert) with chromicized catgut should be made; this, however, involves the peritoneum and the outer portion of the muscular coat, making a lateral rather than an edge-to-edge approximation outside the first line of suture. A rubber tube (No. 24 French) should be inserted in the bladder and fixed to the urethra with silkworm-gut. Three or four holes are made in this tube at the distal end. This is better than a catheter, as it is softer and has a larger lumen. The drain is left in fifteen days. If ordinary commercial catgut is used, there is danger of separation of the line of suture. The peritoneum should have tubal glass or rubber drain. The patient is kept in the Fowler position for four days. When the fistula is between the bladder and the rectum or sigmoid, a rubber tube $\frac{3}{4}$ inch in diameter should be inserted in the rectum and retained there by a peri-anal suture of silkworm-gut. This step prevents tension from gas in the large bowel, thereby greatly favoring the success of the operation.



FIG. 666.—TECHNIC OF REPAIR OF ENTEROVESICAL FISTULÆ.
Gastrectomy clamps applied; double row of continuous mural sutures.

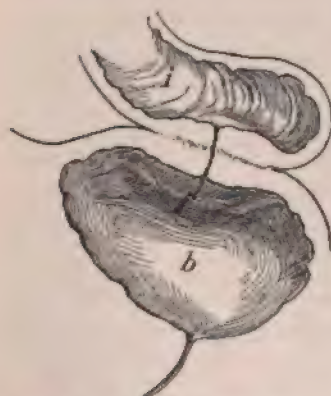


FIG. 667.—ENTEROVESICAL FISTULÆ.
a, Intestine; b, bladder; f, fistula.

closed with longitudinal sutures, and an iodoform gauze drain maintained between the two organs. This should not be removed until the fifteenth day, when sufficient time will have elapsed for organic union. If the rectum or lower portion of the sigmoid is infiltrated to a considerable degree, a combined perineo-

Perineal Route.—The fistula may involve the bladder (Fig. 667), intestine, and vagina simultaneously. The first and most important step in the management of such fistulæ is an extensive separation of the adhesions between the various organs. After this is thoroughly accomplished, the bladder is closed as above described. The bowel must be

abdominal operation with resection of the infiltrated intestine, and transplantation of the sigmoid connecting it with the sphincteric end which has been retained, gives the best results. It is surprising how much of the sigmoid can be brought down without jeopardizing the circulation. End-to-end union with suture through a complete rectovaginal division of the perineum gives the best field for operation, with a fair assurance of success. In all of the above operations a permanent vesical catheter and rectal tube must be employed to prevent tension.

Enterogenital Fistulæ.—By these we understand communications between the small and large intestine (not including the rectum) and the genitalia. This type of fistula is not common. Narath after a careful search through the literature for the last hundred years was unable to collect more than forty cases. Lieblein and Hilgenreiner¹ collected enough more to bring the number up to one hundred and twenty-two.

Etiology.—These fistulæ are either congenital or acquired. The latter alone will be considered here. It may be due to manipulation during attempted abortion, extrauterine pregnancy, or labor. In the twenty-eight cases of communication between the gastro-intestinal tract and the uterus collected by Neugebauer, one-half were due to retained and necrotic fetuses or parts of fetuses. The application of forceps during delivery or the rupture of the uterus is responsible for some of these. The organ perforated is either the uterus or the vagina. A loop of gut protrudes through the opening, is constantly compressed, becomes necrotic, and finally its wall gives way. Curetment for the removal of the placenta may cause a perforation of the uterus. In a case of Rosenthal's a fecal fistula into the vagina formed after manual removal of the placenta. In cases of post-partum sepsis a coil of intestine may become adherent to the peri-uterine exudate and finally perforate it.

Enterogenital fistulæ are occasionally met with independent of pregnancy and labor. Among the causes may be mentioned curetment, trauma, the use of pessaries, vaginal hysterectomies, etc. They may also be of intestinal origin, arising from tuberculosis of the small intestine, appendicitis, diverticula, or malignant growths.

CONGENITAL ORIGIN.	FISTULÆ OF GENITAL ORIGIN.			INTESTINAL ORIGIN.	UNKNOWN ORIGIN.	TOTAL.
	Puerperal.	Post-operative.	Other.			
1	47	47	12	5	13	125

The order of frequency of occurrence of these fistulæ is: enterovaginal, entero-uterine, enterotubal. Of one hundred and two cases, fifty-nine were of vaginal origin, forty-one uterine, and two tubal.

¹ Lieblein and Hilgenreiner: Deutsche Chirurgie, Lieferung 46 C, 1905.

The following table¹ shows the topography of these fistulæ:

VARIETIES.	NUMBER OF CASES.	NUMBER OF FISTULOUS OPENINGS.			TOTAL NUMBER OF FISTULÆ.
		Small Intes- tine.	Large Intes- tine.	Both Large and Small Intestines.	
Enterovaginal	57	46	10	3	59
Entero-uterine	37	25	13	3	41
Enterotubal	2	..	2	..	2
Post-operative	26	24	3	..	27
Total	122	95	28	6	129

The location of the fistulæ as shown by the table is in the small bowel, as a rule, and in its movable segments.

Enterovaginal Fistulæ (Fig. 668).—These may be due to rupture of the vagina during parturition, allowing extrusion of a coil of intestine with subsequent gangrene and rupture. Pressure on a coil of intestine in the posterior cul-de-sac during pregnancy may cause inflammation, with subsequent adhesions and ultimate perforation. Malignant tumors of the uterus, the broad ligaments, or surrounding tissues may confine a coil of intestine in the cul-de-sac, and this in time may become perforated. Vaginal drainage of tubes may be responsible for a fistula; and the clamp method in hysterectomy is often a cause. Trauma or foreign bodies may, but rarely, cause perforations. A fistula was caused by the branch of a tree penetrating the vagina while the patient was descending (Walk).

Among the indirect causes of perforations are infections and abscesses. The surgeon in attempting to open these abscesses may perforate the adherent coil of intestine or the thin attachment of the intestinal wall. These communications are always high up, and on the posterior wall, as a rule; in some cases they are situated laterally.

The *symptoms* are described as escape of flatus and feces through the vagina. The prognosis is unfavorable. While spontaneous healing is rare, examples are recorded (McKeever).

Treatment.—(a) Prophylactic (the prophylaxis of these fistulæ is considered under "Prophylaxis of Injuries to the Intestine").

(b) Internal medication (rest and diet are of no significance).



FIG. 668.—ENTERO-UTERINE AND ENTEROVAGINAL FISTULA.

i, Intestine; u, uterus; f, f, fistulæ.

¹ "Deutsche Chirurgie," Lief. 46 C, 1905, p. 604.

(c) Operative (vaginal, abdominal).

Vaginal Operations.—These are:

1. Enterotomy, after Dupuytren.
2. Suture of the freshened borders of the fistula.
3. Plastic operations through the vagina.
4. Vaginal extirpation of the segment of intestine containing the fistula, followed by entero-anastomosis (Brenner).
5. Exclusion of the intestine.

Abdominal Operations.—1. This route is preferable, assuring the best results. If the fistula is due to a retained fetus, a simple laparotomy is indicated, with removal of the necrotic tissues.

2. Lateral enterorrhaphy; if this is adopted, the vaginal or uterine opening is maintained for drainage; it closes later on.

3. Resection of the intestine; this is indicated where suture is not possible without inflicting additional extensive injury, and where the suture will cause a narrowing of the lumen.

4. Unilateral enteric exclusion.

5. Bilateral enteric exclusion.

The following table shows the results in operative and non-operative cases:

VARIETY.	NON-OPERATED CASES.					CASES OPERATED ON.				
	Cured.	Im-proved.	Unim-proved.	Died.	Total.	Cured.	Im-proved.	Unim-proved.	Died.	Total.
Post-operative fistulæ	11	..	..	2	13	3	..	..	..	3
Other fistulæ	15	12	1	20	48	12	1	3	6	22
Total	26	12	1	22	61	15	1	3	6	25

(The mortality in these cases is materially increased by the delay in operating, as the patients are often *in extremis* before a systematic, intelligent, and forceful effect is made at repair.)

Rectovaginal Fistula (Fig. 669).—This variety may be classified as follows: Openings into the upper part of the vagina; openings involving the middle portion; and, the most common, those involving the sphincteric zone.

These fistulæ may be due to several causes: Complete laceration of the perineum extending into the vagina and rectum; malignant disease, either of the rectum or of the vagina (or cervix), involving one or the other organ secondarily; during parturition lack of elasticity of the perineal floor, use of forceps, craniotribe, too rapid delivery. Indifferent gynecologic work may also give rise to it, as may peri-proctæal abscesses, and strictures of the rectum with infection.

Symptoms.—The principal ones are incontinence of feces and the escape through the vagina of feces and flatus. The passage of the feces causes a constant irritation of the vagina and vulva. In rare cases there may be an inversion of the wall of the

rectum and a protrusion of the same through the fistula. Tumors or other organs may also protrude through the fistulous opening; for instance, Breisky had under observation a fistula high up with a dermoid protruding through the opening.

The diagnosis of a rectovaginal fistula is always simple. The opening may be detected, either by digital examination, rectal and vaginal combined, or by the use of the speculum or proctoscope.

Treatment.—The following methods of operative treatment are all applicable: Tait's¹ flap-splitting operation, Emmet's² method of repair of the perineum, Fritsch's,³ Bureau and Vignard's, and Simon's method.

Fritsch's flap-sliding method consists of an incision in the vaginal wall, the convexity touching the upper margin of the fistula.

The ends of this incision are united by a second one, extending $\frac{1}{2}$ inch below the fistula. The vaginal flap is dissected and the ends of the denuded area approximated.



FIG. 670.—SHOWING DOUBLE ROW OF SUTURES FROM VAGINAL SIDE IN REPAIR OF RECTOVAGINAL FISTULA.

liberated for $\frac{1}{4}$ or $\frac{1}{2}$ inch all around the opening, and a double row of extramucous

¹ Tait, L.: "A Note on Twenty-seven Cases of Perineorrhaphy," Brit. Med. Jour., 1885, ii, 785.

² Emmet, T. A.: "Principles and Practice of Gynecology," Phila., 1884.

³ Fritsch, H.: Loc. cit.



FIG. 669.—RECTOVAGINAL FISTULA.

r, Rectum; u, uterus; f, fistula; v, vagina.

In Bureau and Vignard's method a vertical incision is made on the posterior wall of the vagina, $\frac{1}{2}$ inch above and below the fistula. The vaginal wall is dissected up from the rectal wall $\frac{1}{2}$ inch from the opening. The edges of the rectum are approximated with catgut. Relaxation sutures are inserted between the rectum and the vagina, the vaginal edges are approximated, and finally the tension-relieving sutures are tied.

Fistulæ high up between the rectum and vagina are treated on the same plan as the vesico-recto-vaginal fistula just described. Care must be taken to make extensive resection of the cicatricial and infiltrated tissues; the rectovaginal wall is then

sutures should be inserted from the vaginal side of the rectal wall (Fig. 670). These may be of kangaroo tendon, silkworm-gut, or fine catgut, securing the upper end of the suture by a knot or gutta-percha plug, while the lower end is fastened with lead plates, thus producing a rectal entropion of the cut edges. The vaginal wall may be closed with a whip stitch of fine silkworm-gut, securing the first stitch by a plug of gutta-percha. A proctéal tube should be inserted after all operations for rectal fistula.

The second class of fistulæ can be treated by the same technic. It is easier here, however, to make an extensive separation upward of the rectovaginal wall. If the fistula is such as to leave a small band of tissue at the sphincter, it should be divided and transformed into a complete perineal laceration. Where the laceration does not extend more than an inch and a half above the sphincter, the best method of repair is not a longitudinal suture of the rectum, but the liberation of the anterior rectal wall for from 2 to 3 inches above the fistula, then sliding it down to the sphincter. Once the rectum is attached to the skin, the sphincter can be re-established by buried sutures, and the vaginal wall repaired either by deep continuous, interrupted, or leaded stitches after the usual methods of perineal repair. While this is slow of application, its significance and importance in repair of rectovaginal fistula and complete perineal laceration are not sufficiently appreciated by the average operator. Unabsorbable sutures should not be used. Unabsorbable continuous sutures may be used, however, if the distal end can be readily reached when its removal is demanded. The most common cause of failure in rectovaginal and vesicovaginal fistula is insufficient excision of the cicatricial tissue and deficient liberation of the mucous margins of the opening. (As this chapter does not include lacerations of the perineum, the technic of repair of the third division has been omitted.)

Post-rectal Fistulæ; Cysts; Congenital Fistulæ.—These require special mention in connection with the embryonal remnants of the neuro-enteric canal, or fistulæ resulting from suppuration of post-rectal dermoids. The post-rectal cysts and congenital post-proctéal fistulæ are the results of failure of embryonal occlusion of the neuro-enteric canal. There may be simple pilonidal cutaneous involucra (dermonidal cysts). Again, there may be post-proctéal dermoid pockets communicating with the rectum (mucous excretion), or a fistula may lead from the skin to the mucosa of the bowel.

The variety which concerns us here is the post-rectal fistula communicating with an epithelium-lined pocket behind the rectum. A retrorectal dermoid may become infected and rupture into the rectum, discharging pus and dermoid débris for months and even years. A sinus or opening in the post-rectal region discharging pus, hair, or débris would, of course, lead to a diagnosis, but the surgeon rarely sees the case in this condition. He finds merely an opening leading to a suppurating pocket, or the patient complains of a discharge of pus from the bowel. It may be difficult to locate the opening. However, the post-proctéal infection may be detected and the pathology at once suspected.

The affected parts may be reached by a sacro-iliac incision close to the margin

of the sacrum and coccyx, or by a Kraske¹ incision. By reflecting the bony flap, the wall of the sac can be freed from all of its attachments, severed from the rectum, and removed. The space should be closed at once with catgut sutures. Cysts should be detached from the rectum and the infiltrated zone removed with them. A mural and extra-mural double row of absorbable sutures should be used to close the rectum; the bony flap is then replaced and the post-proctæal space drained. A large permanent rectal drainage-tube is then fixed in position. This class of fistulæ is generally mistreated, since neither drainage nor cauterization can effect a cure; as the cavity is lined with epithelial cells and essentially a muco-cutaneous cavity, excision of the fistula or sac is the only means of radical cure. If the dermoid is inflamed

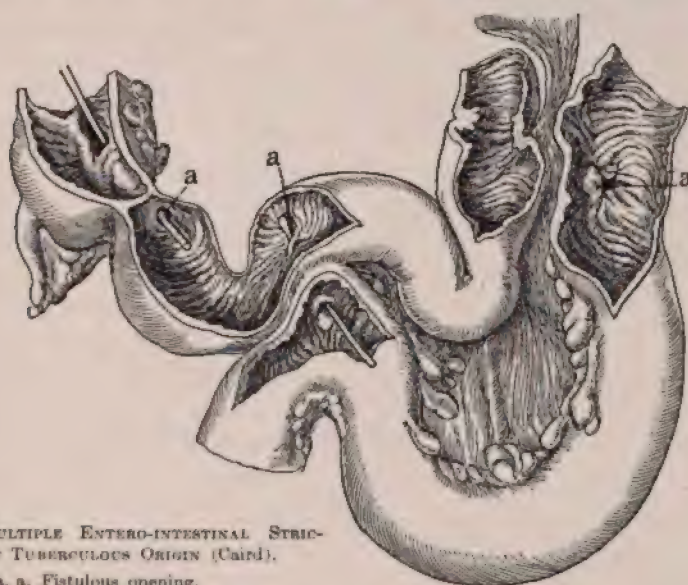


FIG. 671.—MULTIPLE ENTERO-INTESTINAL STRICTURES OF TUBERCULOUS ORIGIN (Caird).
a, a', Fistulous opening.

or infected before the rectal communication is established, it should not be drained, but extirpated by trans-sacral or para-sacral incision.

Infected pilonidal cysts do not belong in gynecologic work, but they are so closely related to the post-rectal infected dermoid that a word is necessary. A complete excision of the epithelium-lined cavity is the only means of radical cure, even though a portion of the rectum has to be sacrificed. Such cysts and fistulæ should never be curetted or injected. Post-proctæal dermoids may attain a size sufficient to displace all the pelvic organs above a line from the symphysis to the promontory, as observed in a case operated on recently by the writer.

Entero-intestinal fistulæ are not at all uncommon. They occur chiefly in the pelvis and are often associated with one of the other forms of fistula mentioned above. If few in number they should be separated and the openings closed with a Czerny-Lembert suture. If multiple (see Fig. 671) and within a circumscribed

¹ Kraske, Paul: "Erfahrungen über den Mastdarmkrebs," Volkmann's klin. Vortr., 1897, No. 183-184.

floor. Its greatest functions, from a surgical standpoint, are to produce abdominal lymphocytosis, circumscribe infected zones, and cover abraded surfaces.

Sigmoid.—This organ is frequently bound in pelvic adhesions. This is, of course, easily explained by its proximity to the pelvic organs. The adhesion of the sigmoid to the pelvic infected zones is often a fortunate occurrence, as it protects the general peritoneal cavity from infection. It is the gynecologist's greatest friend, and to him plays the same rôle as the omentum does to the general surgeon. The appendices epiploicæ rapidly rally to the encapsulation of pelvic infection and to the sealing of pelvic abrasions.

Small Intestine.—Adhesions of the lower and upper segments are very common. When they involve the lower part of the ileum the patient experiences little pain. When adhesions occur between the pelvic organs and the upper ileum, considerable traction is exerted, and much pain ensues. The pelvic organs frequently become infected, produce abscesses which rupture into the intestine, and result in temporary or permanent fistulæ. In a recent case examined by me one year after an oöphorectomy, in which a heavy silk ligature was used, I found an adhesion between the upper jejunum and the stump. The patient had complained for the twelve months of a dragging pain in the left side, which was greatly increased after exertion and on assuming the upright position.

Intestinal adhesions may be single or multiple. I had occasion to remove in an individual case no less than fourteen separate and distinct coil adhesions from a pelvic infection focus.

Rectum.—Exudates and infiltrations, primary and secondary, and peri-proctæal infections produce either traction on the walls of the rectum or compression of the same by formation of fibrous tissue. Sometimes the traction may be so great as to form a false diverticulum.

Urinary Organs.—The ureter rarely becomes adherent to the intestine. Cicatricial tissue will sometimes surround the ureteral tube and constrict it from the outside. In the course of time this may be responsible for hydronephrosis. Adhesions between the ureter and the intestine are caused most frequently by the removal of subperitoneal cysts. The fundus of the bladder may become adherent to the intestine, and as the bladder is more firmly fixed than the intestine, the latter will be subjected to traction. Frequent micturition combined with intestinal symptoms will constitute the clinical picture of such a case.

Prophylaxis.—To obtain a clear idea of how post-operative adhesions may be prevented it is necessary to mention the principal etiologic factors, which are abrasions and infections.

The technic for prophylaxis of adhesions is as follows:

1. A fold of the loose peritoneum in the neighborhood is used to cover the abraded surfaces and should be stayed with absorbable sutures.
2. Involution of the abraded surfaces is the routine protective management of the appendix, mesovarium, mesosalpinx, or other stumps.
3. Covering the abraded surfaces by neighboring peritoneal covered organs, in

such a manner as not to compromise the motility or function of the transplanted organ by traction. It has been my practice for years to transplant the sigmoid over pelvic abrasions. Occasionally I appropriate the uterus to cover rectal abrasions and fistulæ.

4. *Peritoneoplasty*.—By this is meant the covering of abraded areas by peritoneum, for the purpose of rendering abdominal organs extraperitoneal. This originated with Martin, of Berlin. It was also recommended by several other authors, among them Sneguireff, who termed it "autoplasty." Amann advises the reconstruction of the pelvic peritoneal floor by immobilizing or transplanting neighboring peritoneum, or by transplanting organs covered with peritoneum at the denuded area; these must be free from traction. Loewy advises grafting of peritoneum or mesentery upon the abraded areas. The peritoneum is so loosely attached in many places that large flaps can be transplanted with great ease. The pedicle of the flap has great vitality and its life is assured. In cases of pelvic infection where exclusion from the peritoneal cavity is desired, it can be done by sliding the loose fold of peritoneum over the injured surface by displacing the anterior fold of the broad ligament, which can be readily slipped backward and the infected zone excluded.

5. *Ectropion of the Peritoneum*.—By this we understand the eversion of the cut edges of the peritoneum along the line of the abdominal incision, which is effected by a line of continuous sutures $\frac{1}{4}$ inch from the cut edge, so that the union is accomplished between two lateral peritoneal surfaces, thus excluding the raw edges from the peritoneal cavity and avoiding post-operative adhesions at the line of incision. In the past ten years I have had occasion to open the abdomens of patients previously closed by this method, and I failed to see either adhesions between the omentum and the abdominal scar, or between the latter and the intestine. The method is very simple and can be highly recommended.

6. *Prophylaxis by Position*.—In the event of enteroptosis or gastropptosis, where the organs come in immediate contact with the infected parts of the pelvis, and where we are unable to cover the abraded peritoneal areas, the post-operative position of the patient can be used to advantage. During the operation the patient is kept in the Trendelenburg position; when returned to bed she is kept in an exaggerated

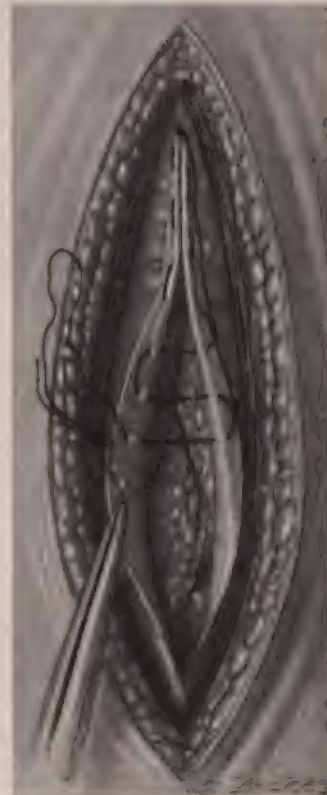


FIG. 672.—CONTINUOUS CATGUT SUTURE PASSED IN SUCH A MANNER AS TO PRODUCE AN ECTROPION OF THE CUT EDGES OF PERITONEUM.

Sims position with the buttocks elevated, which tends to displace the intestines out of the pelvis and diaphragmward during the process of repair.

Distention of Abdominal Cavity by Artificial Means.—The intestines may be separated from each other or from the pelvic organs and the abdominal wall in several ways. Normal salt solution, filtered air, and nitrogen are the means most commonly used.

Anterior fixation is avoided by distention of the abdomen with nitrogen gas or filtered air, which is easily carried out as follows: Before closing the abdomen a hollow needle is inserted in the lower angle of the abdominal wound. The peritoneum is sutured around the needle and the remaining abdominal layers are completely closed. From 100 to 150 cubic inches of nitrogen are injected under a 3-pound pressure from a tank through this needle into the peritoneal cavity until firm distention of the abdominal walls is secured. The needle is then withdrawn and the patient placed in the recumbent position. This vaults up the anterior abdominal wall and prevents contact with the intestines, which are held by the mesentery and gravitate to the posterior wall. The exaggerated Sims position will prevent adhesions in the pelvis, and the Fowler in the upper abdomen. It requires about three or four weeks for complete absorption of the gas. In the meantime endothelial or connective tissue covers the abrasions. I do not know that nitrogen is superior to filtered air, but from the experience we have gained in more than 1600 cases of injection of nitrogen into the pleura without a single infection, I consider the use of nitrogen safer. Perfect filtration and sterilization of air is by no means an easy procedure. Both can be injected through the ordinary oxygen inhaler.

Separation of Adhesions.—When we encounter extensive omental adhesions to fixed structures, they should not be torn. It is better to ligate the omentum above the point of adhesion and allow the stump to retract, leaving the adherent omentum as a flap over the destroyed peritoneal surface. In this case the omentum may be cut straight across, and ligated at any point above the umbilical level. The life of the flap is assured by the collateral circulation, and by allowing it to remain we avoid the necessity—and in many cases the impossibility—of covering abraded surfaces. If the omentum is adherent to pus-tubes or ovary, or to any portion of an infected pelvic floor, the adhesions can be carefully removed with dry gauze or sponges. The sponge is wrapped around the finger and the adherent surface gently rubbed until it becomes detached. If the stump is adherent to the pelvic floor, the separation can be accomplished by dry gauze and gentle manipulation. The abraded surface of the stump may be covered by an omental flap or by peritoneal plication. The separation of the intestine, in case of adhesion to the abdominal scar, can be accomplished in the same manner. The abraded surface of the intestine can be covered by rolling it on its mesentery and fixing it by sutures. Entero-enteric adhesions should not be disturbed unless angulation or traction is present. Cauterization of the surfaces after separation of the adhesions is not advisable, and should be resorted to only in extreme cases. In separating adhesions or scars of ancient suppurative pockets the union is organic, and in the endeavor to free the intestines from such poc-

kets they may be torn. Not infrequently, in separating the adherent types from the small and particularly the large intestine, one finds a fistula leading from one mucous cavity to another, or a communication between the intestinal lumen and an infected dermoid. (The management of this class of cases is treated of under *Fistulæ*.)

In separating intestinal adhesions from ovarian cysts, an incision should be made into the outer layer of the cyst wall, and a thin layer allowed to remain adherent to the intestine. This is a better procedure than complete separation from the intestine, as the latter might be injured in the attempt. The oozing from an abraded surface can be readily controlled by sponges, pressure, or hot air cauterization. After vaginal hysterectomy the small intestine may prolapse into the vagina and become adherent to the wound margins. The separation of such adhesions is very difficult and often impossible. If 6 to 8 inches of bowel are thus compromised, the safest and most expedient method is suprapubic resection of the adherent segment and end-to-end union. Occasionally a coil of intestine is so fixed that it cannot be liberated without dangerous prolongation of time and great trauma to the wall. In this event intestinal exclusion is the most desirable method of management. Drainage is established, and after the infective process has subsided, the excluded coil can be safely extirpated.

When enterovesical adhesions are difficult to separate, it is advisable to leave a portion of the muscularis vesicæ adherent to the intestine, and repair the abraded surface of the former.

Infected tumors and cysts; pelvic abscesses opening into the rectum; infected ovarian cysts (especially infected dermoids); gonorrheal or tuberculous salpingitis, and ruptured ectopic products, may all adhere to the rectum, finally perforating it, and evacuate their contents into the lower bowel.

Though Keen,¹ in his classic treatise on the subject, says that typhoid fever rarely affects the internal genitalia of women, H. J. Boldt observed and accurately reported a case of this type of tubal infection which opened into the rectum. Pyosalpinx of gonorrheal origin may open into the sigmoid or into the rectum, though it is rare, as a simple gonorrhea is seldom virulent enough to produce a tissue necrosis. This probably accounts for the infrequency of tubo-enteric fistula.

Treatment.—The management of infected cysts, pyosalpinx, etc., which open into the rectum or the sigmoid is as follows:

1. Drainage should be free and maintained for a certain length of time to reduce the virulence of the infection, also to increase the local immunity.
2. Removal of the necrotic tissue of the tumor, or of the infected tube.

In the case of an infected or necrotic myoma or infected ectopic gestation, the wall need not necessarily be removed, as it is not epithelium-lined and will close when the débris is removed. The course to be pursued is entirely different when we are confronted with an infected ovarian dermoid or a salpinx, both of which are lined with epithelium. The lining of these cysts must be removed, as agglutination or obliteration of the walls will never be attained, unless it is completely extirpated. The same

¹ Keen, W. W.: "Surg. Compl. and Sequels of Typhoid Fever," Philadelphia, 1898.

may be said of a tube with gonorrheal infection. The fimbriated end is sealed by adhesions, the uterine end closed by a gonorrheal stricture and the intervening mucosa infected. Ablation of the mucous tube is the only means of effecting a permanent cure.

The intestinal opening should be closed by a double row of Pagenstecher linen sutures. Prolonged drainage is not justifiable, as the absorption from the infected dermoid surface is great, and will give rise to grave general sepsis. Furthermore, it is of no advantage, since it never leads to repair if the epithelial lining has not been destroyed.

Often in cystic infections the ablation of the inner wall (its epithelial lining) may be effected without removing the outer cyst wall, as such procedure avoids the possibility of injuring neighboring adherent viscera and leaves a surface that has little, if any, absorptive power; there is therefore no danger of infection.

Relationship between Pelvic Infections, Rectal Infections, Rectal and Perirectal Tissues.—Infections of the broad ligaments—post-abortum and post-parturient—not infrequently extend to the periproctean connective tissue. This is at first infiltrated and becomes necrotic and finally is transformed into an abscess, which should be drained as soon as it is recognized. After drainage there is contraction of the connective tissue, forming a perirectal constriction. These cases are very difficult to treat, as all the neighboring structures are involved, and drawn closely around the rectum. In the treatment of this type of stricture massage and the bougie are more effective than operation.

After operation upon the broad ligaments the periproctean tissue may be infiltrated with blood, giving rise to what is known as “retro-uterine” or “periproctean hematocele.” After the absorption of the blood a stricture is occasionally produced, which calls for the same treatment.

EXAMINATIONS OF RECTUM AND SIGMOID.

These may be divided into palpation—(a) internal, (b) external; distention—(a) gaseous, (b) fluid; inspection.

Internal palpation is of value in the lower 4 inches of the rectum only. It may be accomplished through the vagina in the female and through the rectum in the male. In irritations, fissures, and inflamed hemorrhoids either a local or a general anesthetic should be resorted to. Often an anal lesion is associated with an ulceration, tumor, or stricture higher up; the upper lesions are frequently overlooked and all of the symptoms attributed to the lower lesion.

External palpation of the sigmoid and rectum very often reveals the circumscribed inflammatory mass of the intramural or perisigmoidal infected sinuses, the induration, nodular and woody, resistance of a carcinoma, or the hard, cord-like, knotty mass of a tuberculosis. Distention above the point of obstruction can often be outlined by a careful palpation.

Gaseous distention of the rectum and colon often reveals the point of obstruction

or fixation, and is valuable in outlining the relation of the colon to abdominal neoplasms.

Fluid distention often reveals obstructions or malpositions, and has the advantage of the flat percussion note to more certainly indicate the intestinal position.



FIG. 673.—MURPHY'S TELESCOPING PROCTOSCOPES. RECTAL SPECULUM ON LOWER PART OF ILLUSTRATION.

Inspection is best accomplished with the telescoping proctoscope, which I have devised for this purpose (Fig. 673). The shorter instrument and the one of largest diameter permits of a close inspection of the lower 4 inches of the rectum. The next larger size is passed into this, and without withdrawing it each additional larger one is introduced in succession until the longest sigmoidoscope (14 inches) is inserted.

In this way the patient suffers no pain from the additional introductions and a careful inspection can be made of every inch of the field. The surface should be carefully sponged from time to time, as fecal deposits not infrequently resemble superficial ulcers. The character of the lesion can be very well determined by close and careful inspection. The electric instrument is not as reliable as the reflected light. A long snare may be used through the proctoscope for the removal of polypi and fragments of tumor may be obtained for microscopic examination.

MALFORMATIONS OF THE ANUS AND RECTUM.

The ano-rectal region is the seat of several varieties of occlusion. These may be conveniently divided into two groups: occlusions of the anus and of the rectum.

The anus may be abnormally narrow, due to the skin or muscle being stretched across the opening. The stenosis is generally near the outer surface of the body, and varies in degree from a slight narrowing of the normal passage to almost complete occlusion. In a second variety the anus is closed by a thin membrane through which the bowel contents may be seen and felt.

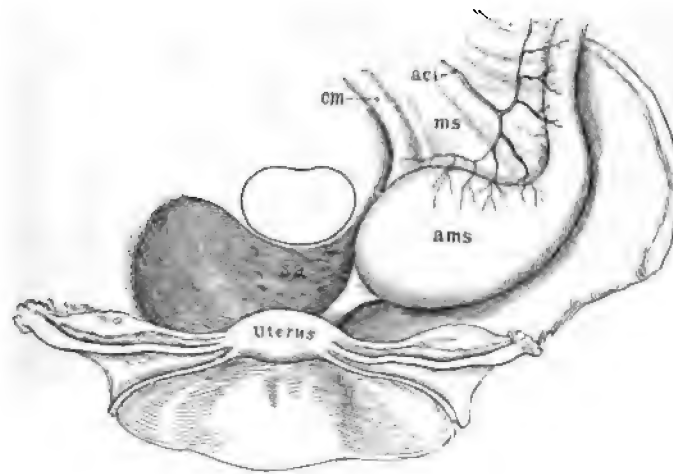


FIG. 674.—TOTAL ABSENCE OF RECTUM (after Chalot).

aci, Inferior colic artery; *ams*, sigmoid ampulla; *cm*, mesocolic cord; *ms*, mesosigmoid; *sa*, sacrum.

This variety is very rare and is easily remedied. A small pit in the skin, which is imperforate, is no indication that the lower end of the rectum is near by; the external sphincter is occasionally wanting.

The rectum is developed from the enterodeum—the hind end of the primitive gut. The anus, on the contrary, is developed by an infolding of the epiblast—the proctodeum. Normally the intervening septum disappears and free communication is established.

The abnormal terminations of the bowel are classified as follows:

1. In some cases the **septum persists** and the rectum ends in a blind pouch at a variable distance—up to several inches—from the perineum. The rectal ampulla is generally to be found near the left sacro-iliac joint. The partition may be thin, but is usually thick. It is rarely perforated, and may be multiple. The intervening space is filled with connective tissue, and in some cases a fibrous cord

runs down from the end of the rectum (Fig. 675). If, as sometimes happens, the anus is apparently normal, diagnosis is obscure unless a thorough examination is made.

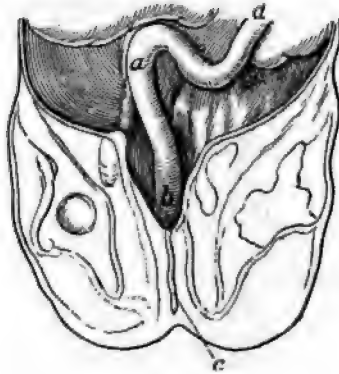


FIG. 675.—IMPERFORATE ANUS.
a, Rectum; b, cul-de-sac of the rectum; c, the cord-like rudiment of the rectum; d, sigmoid flexure.

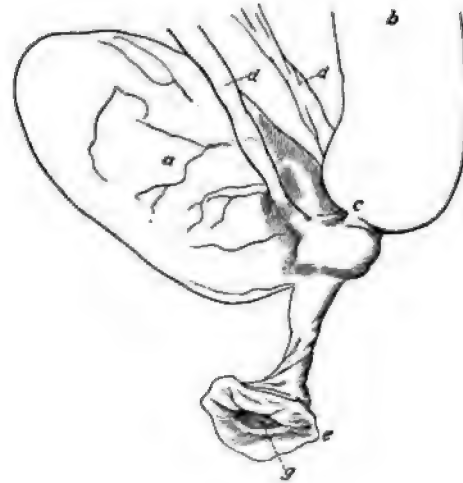


FIG. 676.—APPEARANCE OF IMPERFORATE ANUS, WITH RECTUM TERMINATING IN THE BLADDER (Bodenhamer).
a, Bladder; b, rectum; c, neck of bladder; d, d, ureters; e, e, urethra.

2. In 40 per cent. (Leichtenstern¹) of the cases of rectal malformation, whether the anus is present or not, the rectum opens into some neighboring organ.

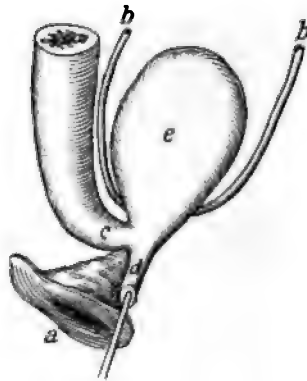


FIG. 677.—SHOWING AN IMPERFORATE ANUS, RECTUM COMMUNICATING WITH URETHRA (Bodenhamer).
a, Vagina; b, b, ureters; c, rectum; d, urethra; e, bladder.

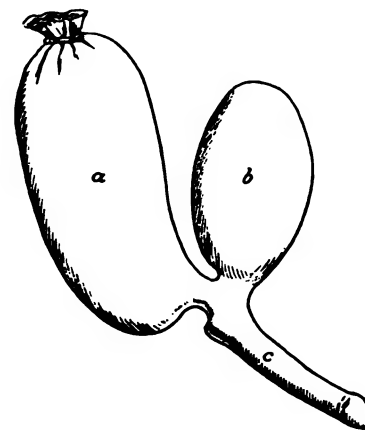


FIG. 678.—RECTUM OPENING INTO THE URETHRA (Bodenhamer).
a, Rectum; b, bladder; c, penis.

This abnormal opening is most commonly into the vagina. When it communicates with the urinary organs, in males it opens more frequently into the

¹ Leichtenstern, O.: "Verengerungen, Verschlüssungen und Lageveränderungen des Darms," von Ziemssen's Handbuch, 1876, vii, 2, 359.

bladder (Figs. 676, 679, 683); occasionally into the urethra (Figs. 677, 678). In females, on the other hand, the opening is generally into the urethra (Fig. 677), seldom into the bladder. This variety is not incompatible with existence, and several cases are recorded in both sexes where the patients have reached adult life.

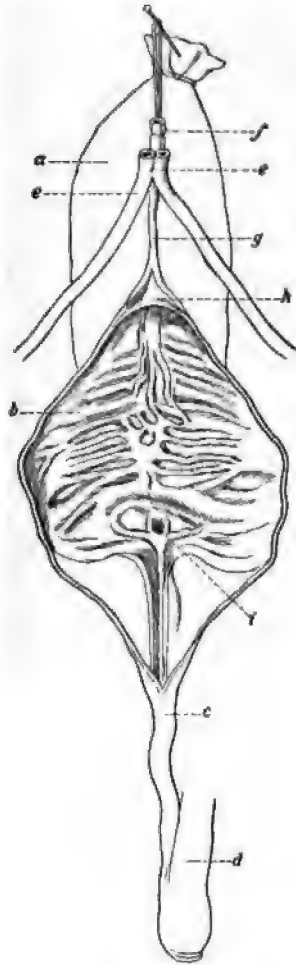


FIG. 679.—IMPERFORATE ANUS WITH RECTUM OPENING INTO THE BLADDER (Bodenhamer).

a, Rectum; *b*, bladder laid open; *c*, urethra; *d*, penis; *e*, *e*, umbilical arteries; *f*, umbilical vein; *g*, ligament leading from the bladder to the umbilicus; *h*, urachus within the ligament; *i*, rectovesical opening.

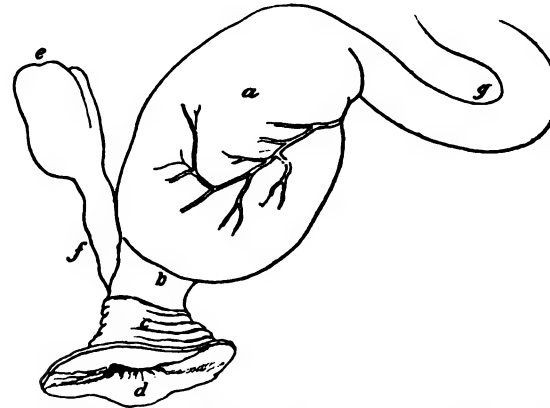


FIG. 680.—ANUS AND RECTUM SEPARATED BY A SEPTUM DUE TO FAILURE OF COALESCENCE (Bodenhamer).

a, The large sac-like opening; *b*, the point of occlusion of rectum; *c*, circular fibers of the external sphincter; *d*, normal anus; *e*, bladder small and contracted; *f*, the urethra; *g*, sigmoid flexure of the colon.

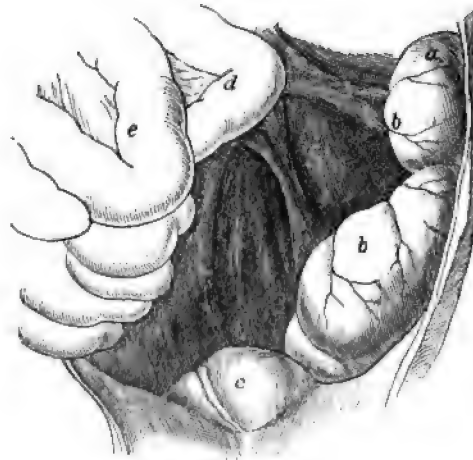


FIG. 681.—IMPERFORATE ANUS AND RECTUM WITH DISTENTION OF SIGMOID (Bodenhamer).

a, Descending colon; *b*, *b*, sac-like dilatations of colon; *c*, bladder, behind which colon passes; *d*, *e*, the small intestine in normal condition.

3. The anus being imperforate, the rectum opens on the skin.

4. The primitive cloaca persists owing to non-development of the normal septa, and the rectum and vagina end in a common passage as in some of the lower

animals. This variety, too, does not hazard life. In practically all of these deformities there is enormous distention of the rectum and sigmoid.

5. Total absence of the rectum is rare (Figs. 674, 685). In a series of four hundred and sixty-five cases of

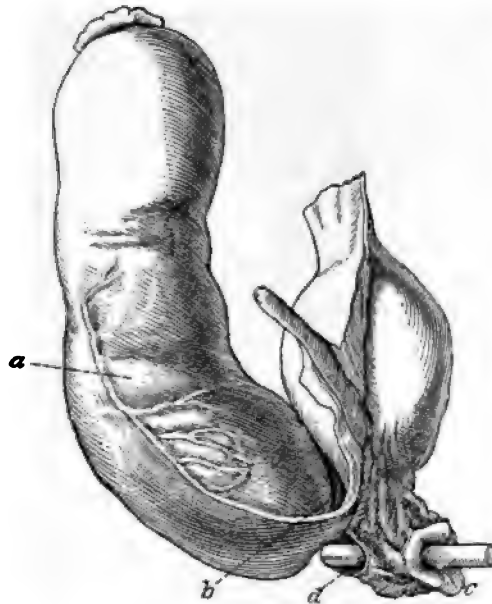


FIG. 682.—ANUS AND RECTUM SEPARATED BY A SEPTUM DUE TO FAILURE OF COALESCENCE (Bodenhamer).
a, Rectum greatly distended; b, cul-de-sac of rectum at point of occlusion; c, sigmoid flexure of colon; d, bladder.

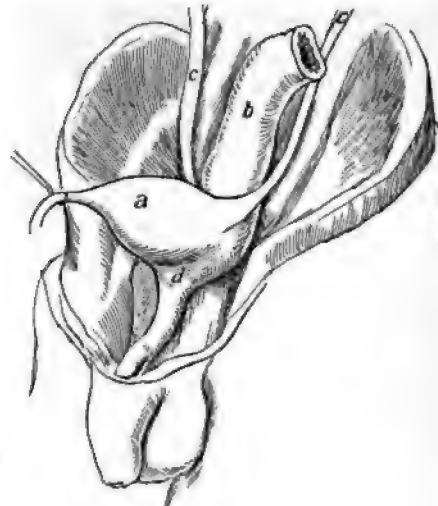


FIG. 683.—SHOWING RECTUM EMPTYING INTO THE BAS FOND OF THE BLADDER (Bodenhamer).
a, Urachus; b, rectum; c, c, ureters; d, urethra.

ano-rectal malformations collected by Bodenhamer,¹ in only forty-one were the rectum and colon entirely absent.

The *symptoms* of these occlusions naturally manifest themselves soon after birth. If there is no discharge of meconium, it may at first be attributed to constipation, but the speedy development of vomiting and colic set one aright.

As regards *treatment*, the simple stenosis of the anus may only require dilatation with the oiled finger or a bougie. In some, however, dissection of the occlusion is more satisfactory. In the cases of imperforate rectum, if the blind end is not too far from the

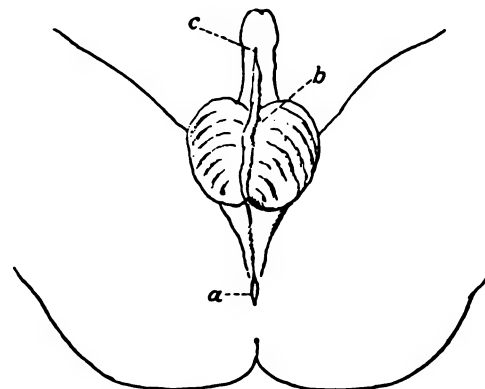


FIG. 684.—REPRESENTS THE PERINEUM AND GENITALS, SHOWING LINE OF DIVISION OF PERINEUM FOR CONGENITAL RECTAL ATRESIA (after Cruveilhier).

a, The artificial opening made at the normal situation of the anus; b, the rugous and prominent raphé, which became linear as soon as meconium was voided; c, the abnormal aperture, or anus.

¹ Bodenhamer, W.: "Malformation of the Rectum and Anus," New York, 1860.

surface, it may be brought down, and stitched in place, with or without removal of the coccyx. If too far away for this procedure lumbar or inguinal colostomy is called for. In these severe cases there is not much time for delay, and the danger from stercoremia renders speedy relief necessary.

In some cases the after-treatment is complicated by marked constipation, due either to the undeveloped musculature of the bowel or to scanty intestinal fluids.

This is relieved, as a rule, by appropriate remedies, as castor oil or other simple laxatives.



FIG. 685.—ABSENCE OF ANUS AND RECTUM (Bodenhamer).

a, The liver above the commencement of the ascending colon; b, the ascending colon which here takes the place of the cecum, and is divided into two branches, from one of which springs the appendix; c, the descending colon hanging loosely in the abdominal cavity; d, the blind end of the colon; e, e, e, e, the parietes of the abdomen.

into the muscularis, we should consider the condition malignant, even though it appear benign clinically.

BENIGN TUMORS.

Adenoma (Figs. 686, 687).—This variety is common in the rectum and is most frequent in young subjects. Children who have enlarged tonsils and nasal polypi not infrequently have rectal adenomata. These tumors may be single, but are generally multiple. They are very prone to undergo malignant degeneration, especially in early adult life. So common is this that the condition polyposis intestini is a common forerunner of malignancy in all portions of the intestinal

TUMORS OF THE RECTUM.

A classification of tumors into benign and malignant answers all practical purposes, but, as is well known, it is frequently impossible to differentiate a benign growth from a malignant one by the appearance. Those which are apparently perfectly benign microscopically, have the clinical characteristics of malignancy. Adenomata which microscopically appear benign, clinically prove to be very malignant. In tumors of the glandular type Rokitansky's¹ law holds good—i. e., glands out of place are a sign of malignancy. If, for example, we find that the glands of the mucosa are displaced deep

¹ Rokitansky, C.: *Lehrb. Path. Anat.*, 1861, Bd. iii.

tract. The most painstaking ablation of these tumors should be accomplished immediately after their recognition. The avoidance of malignancy can be prevented only by early and thorough excision.

The peritoneum may be opened accidentally during the operation; in this event it should be carefully sutured from the interior of the rectum. If the opening is very large, a suprapubic section should be resorted to and the aperture closed by a Lembert suture. A rubber tube must always be left in the rectum to prevent distention from gas.

Papilloma is frequently met with in the lower part of the rectum, or, to be more exact, at the mucocutaneous junction. They are sessile growths, have a tendency to increase in size, and if they extend to the rectum may cause obstruction and venous stasis. As is the case with the adenomata, they are subject to malignant degeneration.

These growths can be removed by a careful submucous dissection or by the Paquelin

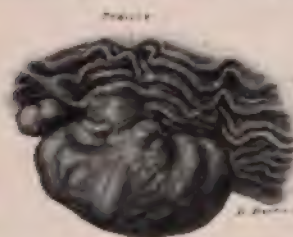


FIG. 686.—PEDUNCULATED ADENOMA OF LARGE INTESTINE (Watt's case).



FIG. 687.—ADENOMA OF INTESTINE WITH DEPRESSION AT ITS BASE.

a, Adenoma; b, depression.

cautery, as they never penetrate the wall. If they are excised, the raw surface should be cauterized. For all cauterizations the writer has adopted the artist's open-tipped pyrography burner. This has the advantage of incinerating the tissues with the hot gas, without contact, as in the other cauteries, whereby the eschar is often pulled off with the instrument. It is easily kept in order, a decided advantage over the Paquelin.

Fibroma.—These originate from the submucous tissue and vary in size. The largest on record was one extirpated by Bowlby, which weighed 800 grams.

Lipoma is rarely met with and originates from the fat in the vicinity of the rectum.

Dermoids may originate in the retrorectal tissues. (Their description and treatment are referred to elsewhere.)

Cysts.—Retention cysts are met with, due to damming up of the secretions of the glands about the anus and the surrounding skin.

Myoma, *fibromyoma*, *chondroma*, and *osteoma* are all found in this region occasionally, but need no special mention.

General Treatment of Non-malignant Tumors.—The main questions to be considered are, Does the tumor involve the mucosa alone? and, Is the growth situated below or above the level of the peritoneal folds? Tumors involving only the mucosa can be dissected away from the submucous tissue easily and safely. Adenomata, as we have stated, have a tendency to involve the submucous and muscular coats; therefore, while they have the aspect of benign tumors, they should be treated as malignant growths—by radical extirpation including the rectal wall. When the tumor is situated high up, excision must be very carefully performed lest the cul-de-sac of the peritoneum be opened. If this is not recognized at once, life is generally sacrificed. If the pedicle is small, simple ligation followed by amputation is the safest method; the ligature causes pressure necrosis and agglutination, avoiding danger of peritonitis.

The pedicle should never be transfixed. If the ligature penetrates the peritoneum, it opens a direct track for infection; if it penetrates a vein, it leads to hemorrhage and pyelephlebitis. The writer has observed all these pathologic conditions. When the tumor is sessile, an intestinal clamp should be placed on the base, and the tumor amputated; the pedicle should be cauterized to secure hemostasis and prevent infection.

MALIGNANT TUMORS OF THE RECTUM.

Carcinoma.—Varieties:

1. Squamous-celled or epithelioma, always found at the muco-cutaneous junction.
2. Glandular or adenocarcinoma. This is subdivided into (a) medullary, and (b) scirrhus, according to the greater or lesser abundance of epithelial compared to the connective-tissue elements.
3. Melanotic pigmented adenocarcinoma, indicating a superlative degree of malignancy.

We learn from Gant¹ that 5.9 per cent. of all carcinomata originate in the rectum, and that it is the site of 80 per cent. of all intestinal cancers. In his own practice 52 per cent. of rectal carcinomata occurred in males and 48 per cent. in females.

The etiology of carcinoma in the rectum is the same as elsewhere in the body, apparently the sequence of mild, frequently repeated irritations and pressure.

There may be no symptoms for a considerable length of time, though after the tumor reaches a certain size symptoms of pressure and pain are noticed. There is tenesmus, and constipation alternating with diarrhea. The most characteristic sign, however, is a mucous discharge independent of bowel movements, which is usually the first one to attract the patient's attention. The mucus may be streaked or mixed with blood. With the lapse of time, the growth ulcerates, saprophytic decomposition ensues, giving the foul odor so characteristic of carcinoma. In the scirrhus variety there is a tendency to stenosis. From now on the patient exhibits

¹ Gant, S. G.: "Diseases of Rectum and Anus," Phila., 1902.

the same train of symptoms as in carcinoma elsewhere. Rectal examinations are entirely too infrequent, considering the common occurrence of rectal irritation and its sequential carcinoma.

Sarcoma.—In strong contrast to carcinoma, sarcoma of the rectum is rare. Moreover, while sarcoma in other parts of the body is found in young subjects, as a rule, in the rectum it occurs well along in adult life. It never tends to stenosis, rarely ulcerates, but occasionally gives rise to hemorrhage. The lumen of the intestine is increased, the wall is indurated but smooth.

Metastases in Carcinoma and Sarcoma.—In the first stages of carcinoma the disease is purely local. At this time there are no metastases, which is a forceful argument for early removal. Later we may expect metastases in 50 per cent. of the cases (Gant). Carcinomata in the zones richly supplied with lymphatics are prone to early metastases; for example, the rectovesical fold, the sphincteric zone, and the muco-cutaneous junction. No one has yet determined how soon after the primary invasion of the basement membrane by the erratic epithelial cells metastatic displacement of these cells takes place. It is a clinical fact that the greater the proportion of connective tissue and the more scirrhus the growth, the later the metastases. Experiments have shown that the degree of toxicity of a cancer is in direct ratio to the percentage of epithelial elements in the growth. The scirrhus is the least, the encephaloid the most toxic.

General Treatment of Malignant Tumors.—This may be divided into palliative and radical. It is not necessary to devote much time to a consideration of the palliative treatment, as it is an uncalled-for and dangerous waste of time, save in inoperable cases. The *x*-ray is not considered an exception to this rule. In the inoperable cases the use of zinc chlorid or the cautery greatly relieves the sense of pressure and diminishes the discharge, thus lessening the discomforts from the disease.

Technic of Zinc Cauterizations in Inoperable Cases.—After the artificial anus has been established, the carcinomatous zone cureteted, and hemostasis secured, an upper packing of dry gauze is inserted to protect the healthy mucosa. The ulcerated and excavated zone is then packed with gauze saturated in a 30 per cent. solution of zinc chlorid. A lower packing of sterile gauze is now introduced and allowed to remain for thirty-six hours after the cauterization. Frequent lavage with boric acid or lysol will hasten cicatrization.

Radical Treatment.—The rectum was first extirpated by Pajot in 1739, later by Morgagni¹ and Lisfranc.² It may be removed through the perineal, sacral, abdominal, or abdomino-perineal routes. The following varieties of operations are applicable to the varying pathologic conditions:

1. Bloodless dilatation of the sphincter. (Simon.)
2. Circular incision around the anus. (Lisfranc.)

¹ Morgagni, J. B.: "Seats and Causes of Diseases," London, 1769, L, 50.

² Lisfranc, J.: "Mémoire sur l'excision de la partie inférieure du rectum devenue carcinomateuse," Paris, 1830.

3. Perineal methods:

- (a) Posterior division of sphincter. (Dieffenbach.)
- (b) Posterior longitudinal incision with retention of the anus and sphincter. (Kocher.)
- (c) Resection of coccyx. (Kocher.)

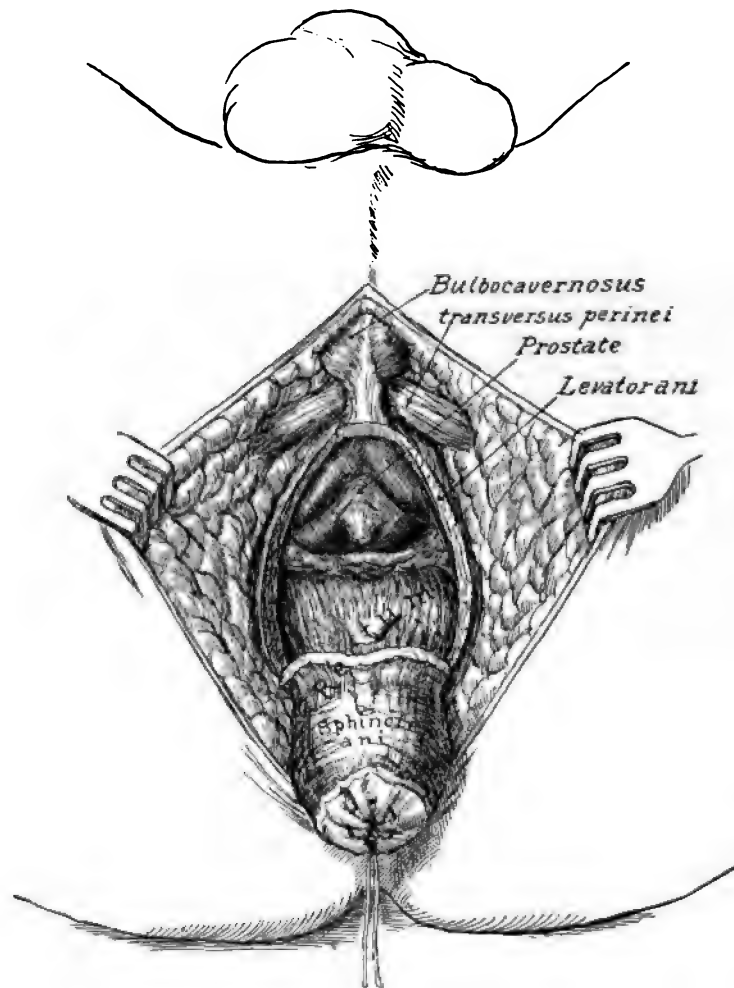


FIG. 688.—QUÉNU'S METHOD.
Shows first step of freeing of anus and rectum.

4. Transsacral method with resection of portions of sacrum:

- (a) One-sitting. (Kraske; in America, Fenger.)
- (b) Transverse section. (Bardenheuer; Rose.)
- (c) Oblique section. (Hochenegg.)
- (d) Transverse resection of sacrum and coccyx. (Heineke; Schlange; Kocher; Hegar; Rydygier; Marcy.)

5. Parasacral methods, division of soft parts on side of sacrum without section or excision of sacrum or coccyx. (Zuckerkindl; Wölfler; Schelkly.)
6. Vaginal extirpation. (Des Quins; Norton; L. L. MacArthur; Campenon; Rehn; Vautrin; Price; Byford; Bristow; Julius Sternberg.)
7. Primary vaginal celiotomy, examination of extent of disease and then com-

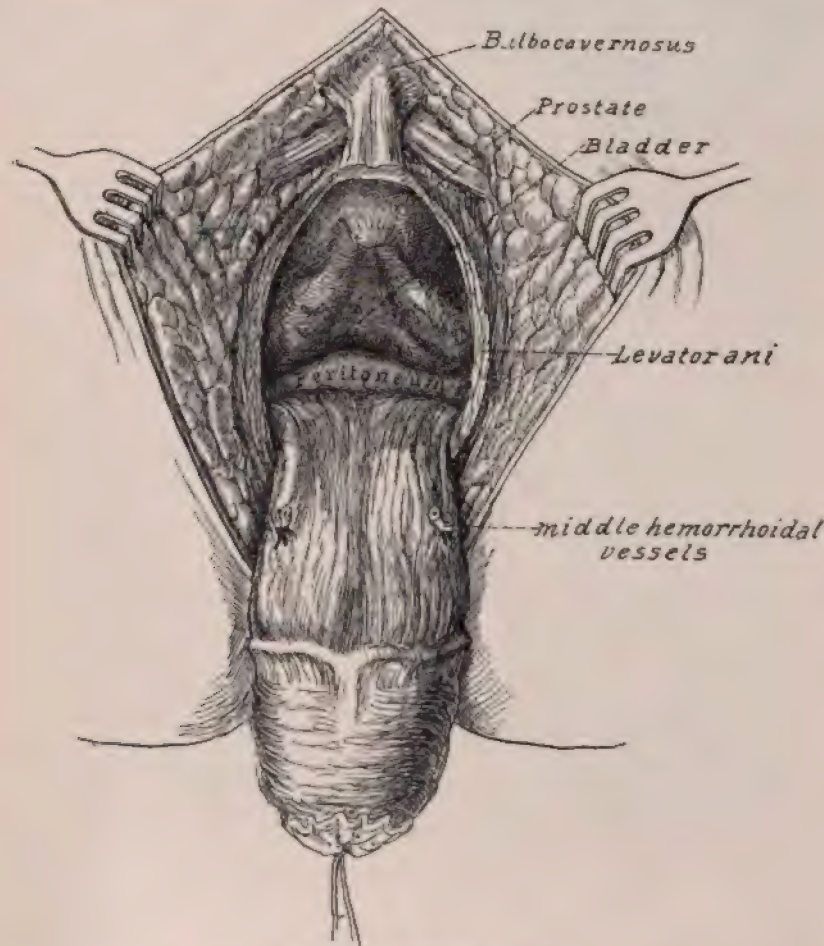


FIG. 689.—QUÉNU'S METHOD.
Showing method of freeing middle portion of rectum.

plete division and later excision with end-to-end union of intestine—retention of sphincter. (Rehn; Murphy.)

Brief descriptions of a few methods:

Quénu's¹ Perineal Method.—Place the patient in the lithotomy position and cauterize the anal mucosa. If the sphincter is to be preserved, dissect the mucosa free or divide the rectum circularly above the muco-cutaneous junction and sphincter

¹ Quénu et Hartmann: "Chirurgie du Rectum," Paris, 1895-99.

border. Then split the sphincter in the median line in front and behind, displacing each segment laterally. Deepen the incision by dividing muscular fibers down to the coccyx and sacrum. The rectum is then liberated on its anterior wall up to the cul-de-sac (Fig. 689). To gain more room posteriorly remove the coccyx and free the rectum from its attachments as high up as the promontory of the sacrum. After liberating it for about 5 inches, the cul-de-sac is opened (Fig. 690), the tissues on either side of the bowel are clamped close to the latter, and then divided between the

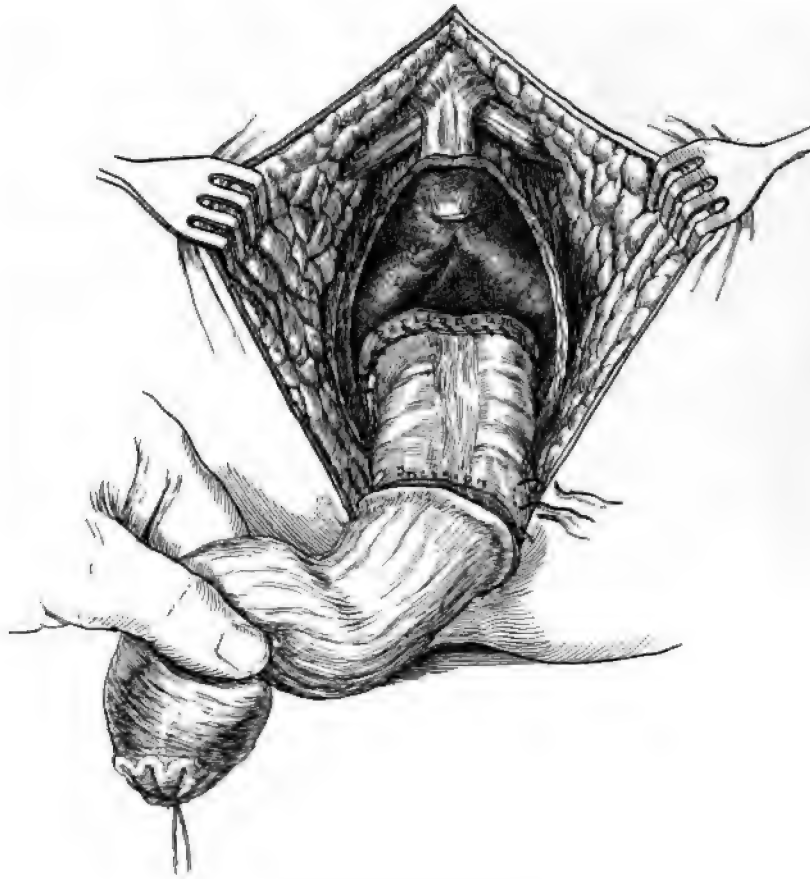


FIG. 690.—QUÉNU'S METHOD.
Showing division of sigmoid and suture of same to skin.

clamps and the bowel. The sigmoid is then liberated and drawn down to permit its attachment without tension to the cutaneous margin (Fig. 690). The rectum is excised and the sigmoid accurately sutured to the cutaneous margin or sphincteric stump of the rectum. Post-proctéal drainage should be instituted. Quénu reports a series of thirteen cases, with two deaths, one from sepsis and the other from gangrene of the gut.

Much time can be saved, and greater accuracy of technic exercised, if after mak-

ing the supra-sphincteric circular division the anterior and posterior walls of the rectum are split with the scissors up to the cul-de-sac and promontory, without any previous freeing of the walls. The lateral halves can then be readily freed from the neighboring structures by a spreading dissection with the scissors. The operation may then be completed as above.

Sacral Proctectomy.—In 1880 Bardenheuer suggested that a portion of the sacrum be removed in order to gain more room, and allow removal of the rectum higher up. The credit of perfecting this to a practical operation belongs to Kraske (Figs. 691, 693), who in the same year described the procedure in detail as follows:



FIG. 691.—KRASKE'S OPERATION. COCCYX AND PART OF SACRUM EXCISED; RECTUM EXPOSED.

The patient is placed on the right side; a median incision is made from the middle of the sacrum to the tip of the coccyx, and the tissues divided down to the bone from the third sacral vertebra. The sacrum is divided with bone forceps transversely at the upper angle of the wound, and its lower half with the coccyx is deflected to the left; the rectum is freed from its attachments posteriorly. The patient is then changed to the lithotomy position; the anterior attachments of the rectum are then severed, freeing it completely. The rectum and sigmoid are then drawn down, the former excised, and the latter united to the sphincteric stump or the cutaneous margin. The lower end of the bowel may be sutured to the post-sacral

free from accidental wounding of the peritoneum. The mortality by these procedures in fourteen of the larger clinics was 21.2 per cent. (Prutz¹).

Attempts at removal of the pathologic conditions in the rectum through the vagina were made as far back as 1890. We find the operation of vaginal proctectomy advancing in the direction of the peritoneum and sigmoid, without any definite plan as to vaginal celiotomy for the removal of carcinoma of the first part of the rectum or lower part of the sigmoid.

The following is the technic of an operation first performed by the writer in 1898,² on a patient with a malignant tumor of the first and second portions of the rectum.



FIG. 694.—VAGINAL PROCTECTOMY.

Sagittal section showing the normal relationship between vagina and rectum. The malignant growth is shown occupying the first and second portion of the rectum. The lines of intended excision are shown.

With the patient in the lithotomy position, the vagina was dilated with broad specula, the cervix drawn down, and the cul-de-sac opened by a transverse incision similar to that used in vaginal hysterectomy. Large laparotomy sponges were inserted into the peritoneum to retain the intestines; the rectovaginal septum was divided down to the rectal wall in the median line from the cul-de-sac to the sphincter (Fig. 695). Hemorrhage from the dilated veins was readily controlled. The posterior vaginal wall was dissected from its attachment to the rectum; retractors were placed laterally

¹ Prutz, W.: "Bemerkungen zur Statistik der sacralen Exstirpation des Mastdarmkrebses," *Arch. f. klin. Chir.*, 1900, lxii, 398.

² Murphy, J. B.: "Resection of the Rectum per vaginam," *Phila. Med. Jour.*, 1901, vii, 383.

and anteriorly so as to secure a large field for operation (Fig. 696). The sigmoid was handled throughout its entire extent and brought down without difficulty. (I wish here to emphasize this mobility of the sigmoid by referring to a case in which an operator perforated the posterior wall of the uterus with the curet, and drew down through the opening 17 inches of the sigmoid and colon.) The anterior rectal wall to the sphincter is divided with scissors as far as the lower border of the tumor. The anal segment is separated from the tumor by incision from 1 to 1½ inches below



FIG. 695.—VAGINAL PROCTECTOMY.

a, Denudation of vaginal mucosa on the posterior fornix with divided peritoneum; b, vertical incision in the rectovaginal septum.



FIG. 696.—VAGINAL PROCTECTOMY.

a, Dissection of rectovaginal flaps separating them from their rectal attachments; b, retractors placed in position.

the growth; this incision must extend into the post-rectal connective tissue (Fig. 697). The proximal end of the rectum is grasped with short gastrectomy forceps, thus closing it completely. Then with curved scissors an extensive dissection is made, liberating the rectum from the coccygeal and post-rectal attachments, upward to the promontory of the sacrum, and even over the iliac vessels (Fig. 698). During this stage of the operation the hemorrhage is very profuse, but can be easily controlled by forceps and pressure. The sigmoid is loosened sufficiently to allow the healthy por-

tion of the bowel to come well down. The rectum is double clamped and amputated $1\frac{1}{2}$ inches above the upper border of the tumor growth. The sigmoid and sphincteric segment of the rectum are united end-to-end with silk. The sutures are passed from within outward, so all the knots are on the inside of the bowel; the ends of the sutures are left long and drawn down through the anus to facilitate removal. The incision in the anterior wall of the rectum is closed with silk, also introduced in the manner just described. The sphincter, if divided, is then united by buried sutures of catgut



FIG. 697.—VAGINAL PROCTECTOMY.
T-shaped incision on the anterior wall of the rectum.



FIG. 698.—VAGINAL PROCTECTOMY.
a, Segment of rectum with growth excised; b, proximal end of healthy rectum; c, stump of distal end.

(Fig. 699). The laparotomy sponges having been removed, the peritoneal cavity is shut off by closing the peritoneum with a continuous catgut suture. The vaginal wall is sutured to the cervix by closing the transverse incision, and the edges of the vertical incision are united in the central raphe with deep silkworm-gut sutures including the perineal muscles (Fig. 700). A large rubber drainage-tube, an inch in diameter, is introduced into the rectum and sewed in place.

The advantages offered by the vaginal route are:

1. The sacrum and posterior bony wall of the pelvis are not disturbed.

2. The field of operation is as extensive and the anatomic parts as accessible as in the transsacral operations.
3. The peritoneal cavity is opened in both the vaginal and sacral operations, and in neither is it a source of great danger.
4. The diseased tissue is more accessible for inspection and the extent to which the operation may be carried in an upward direction is as great, if not greater, than by the sacral route.
5. The peritoneum may be drained freely through the vagina.



FIG. 699.—VAGINAL PROCTECTOMY.
Silk sutures closing opening on anterior rectal wall, all knots tied within the rectum.



FIG. 700.—VAGINAL PROCTECTOMY.
Vaginal wall sutured to cervix, closing transverse incision; vertical incision closed with kangaroo or chromoform sutures.

6. A perfect end-to-end approximation, either by suture or by the use of the button, may be secured. The preferable method of uniting the two ends is by interrupted sutures of silk, because as there is no peritoneum on the sphincteric segment, failure of union with the button is to be feared.
7. The sphincter is retained and the perineal body is restored. There is diminished action of the levator ani muscle.
8. When the operation is complete, the parts are practically in their normal positions.

I have performed the same operation on the male cadaver, and find that by splitting the sphincter directly through the median line, anteriorly and posteriorly, cutting back to the coccyx and opening the rectovesical fold of the peritoneum, practically the same field for operation can be obtained as in the female. Several inches of the bowel can be excised and end-to-end union secured. Either ante-proctéal or post-proctéal drainage may be used. The cut ends of the sphincter are united anteriorly and posteriorly. The lateral nerve-supply on either side is not disturbed.

Abdomino-perineal Operation.—The following is a description of this operation by C. H. Mayo:¹

“The patient is placed in the high Trendelenburg position and the abdomen freely opened in the middle line. The upper limits of the growth and its relation to the surrounding tissues are noted. The possibility of the removal of all of the obviously infected glands is ascertained, and the liver examined for embolic carcinoma. If the case is a favorable one, the intestines, with the exception of the sigmoid, are carefully packed away with large gauze pads; two clamps are caught across the lower sigmoid on a level with the promontory of the sacrum and the bowel divided between. The mesosigmoid is liberated by lateral incisions and the proximal fragment brought up outside of the abdominal wound. A ligature is thrown around the bowel immediately below the forceps, which are removed as the ligature is drawn tight. A purse-string suture is placed an inch below the end of the stump, which is invaginated in a manner similar to that of the appendix. The ends of the ligature are left long. The threads and stump are carefully cleansed. The distal stump is treated by inversion in a similar manner, to prevent soiling. Lateral and anterior peritoneal incisions are now made, liberating the rectum from the bladder and prostate in the male and from the uterus in the female. The inferior mesenteric artery, which is the upper continuation of the superior rectal, is caught and tied above and to the left of the promontory of the sacrum at as high a point as can be safely done without interfering with the nutrition of the bowel used in the colostomy. The fat is carefully separated; the entire mass of gland-bearing fascia, with the fat, is wiped perfectly clean to the periosteum. The middle sacral artery is of considerable size in most cases, and should be caught and ligated near its origin from the abdominal aorta between the common iliac vessels. The dissection is continued downward, exposing the internal iliac vessels and the ureters. Most of this can be done by sponging. The middle hemorrhoidal vessels are caught laterally, as they come off with the inferior. The entire area is now packed with hot moist gauze, and the patient put in the perineal position. In some cases, if the bowel is healthy for a space of four inches above the anus, it is clamped and ligated at this point, and cut above the ligatures, the diseased area being removed. The operator, or preferably a second operator, begins the lower part. A pair of forceps are passed into the blind pocket of bowel from below, the tied end of the bowel

¹ Mayo, C. H.: “Cancer of the Sigmoid and Rectum,” *Surgery, Gynecology, and Obstetrics*, 1906, iii, 236.

is pushed into the open forceps, and they are withdrawn through the anus, inverting the bowel.

"After cleansing, the thread of closure is cut and the forceps are now passed through the invaginated bowel and anus into the pelvis to grasp the proximal end of bowel, which is withdrawn, and the two ends united by a circular end-to-end closure outside the anus and allowed to retract. Drainage is secured by a midline incision in front of the coccyx, through which tube drainage into the pelvis is made. In some colostomies the lower end of the rectum can be saved as a blind pouch, or temporarily employed for drainage of the pelvis. Should the disease require such extensive removal of the rectum as to destroy the lower rectal wall muscles and nerves, as well as straighten the sigmoid loop, thereby losing both retention and control, it is preferable to save the sigmoid loop as such and make an abdominal anus. To employ this method, a small gridiron incision is made on the left side, as would be done on the opposite side for appendicitis, and through this opening, using the ends of the threads as a tractor, the proximal stump is pulled out three-fourths of an inch beyond the skin surface. Three or four linen sutures are quickly placed, uniting the bowel to the peritoneum on the inner side, and a silkworm-gut suture on the outside closes each angle of the wound, including in its bite the skin, aponeurosis of the external oblique, and the wall of the bowel, holding it securely in position. If this plan is followed, the operator from below, after inserting the gauze in the rectum to facilitate subsequent dissection, and closing the anus by a circular suture, circumscribes the anal margin with a deep incision, and dissects the perineal portion of the rectum with its muscles and fat free from the prostate and urethra, or from the vagina in women. This extends up to the levator ani muscle, which forms the boundary between the upper and lower dissections. The abdominal operator now passes down the fragment of lower sigmoid and the upper end of the rectum with its fat and glands into the perineal opening, where they are removed by the surgeon working below, or one operator, with changes of gloves, can accomplish the work in both fields. All bleeding-points are caught and ligated. A considerable sized gauze drain is passed from above downward, leaving its upper end exposed just on a level with the peritoneum, which is drawn together to cover as much as possible, the external gauze portion being brought out of the perineal wound. The sigmoid loop from above is placed over the exposed surface, and in the female the body of the uterus and broad ligaments are adjusted with a few sutures to aid in covering. The upper incision is completely closed, while the perineal opening is narrowed to proper dimensions for drainage by a few sutures.

"The end of the sigmoid is left completely obstructed for the first twenty-four hours, after which time the circular suture is cut and the stump everted by the ligature, which is tied around it, and the bowel opened.

"The advantages of the operation herein outlined are obvious. The disease is removed widely, with all of its tributary lymphatics, muscles, and related tissues. The anus is placed in a position easy of inspection and cleansing; the sigmoid trap obviates the necessity of frequent stools, and the intermuscular incision gives a fair degree of control."

The following statistics are of great practical interest in the rectal cancer problem :

STATISTICS OF OPERABILITY OF RECTAL CANCER.—(*Gant.*)

	PERCENTAGE.
Czerny (Heidelberg).....	71.1
Zurich clinic.....	50.0
Zurich clinic.....	55.8
Göttingen.....	78.3
Marburg.....	75.4
Breslau.....	16.6
Freiburg (Kraske).....	73.0
Rostock.....	47.2
Von Bergmann's Clinic.....	80.0
Bonn (Schede) (Added by the writer).....	78.7

VOGEL'S MODIFICATION OF KRÖNLEIN'S TABLE ON THE OPERABILITY AND MORTALITY OF KRASKE'S OPERATION.—(*Gant.*)

OPERATOR.	NO. OF CASES TREATED.	PERCENTAGE OPERATED.	PERCENTAGE OPER- ATIVE MORTALITY.
König.....	120	78.3	32.5
Czerny.....	151	71.1	10.0
Krönlein.....	110	57.2	11.1
Gussenbauer.....	259	56.0	22.7
Von Bergmann.....	155	80.0	32.0
Madelung, Garré.....	115	46.0	19.0
Kraske.....	110	78.0	11.7
Küster.....	126	75.4	25.2
Hochenegg.....	141	66.0	8.6
Mikulicz.....	109	60.6	25.7
Helferich.....	46	48.0	13.6
Schede.....	66	80.3	32.0

PERMANENT RESULTS OBTAINED FROM RECTAL EXCISION BY LEADING OPERATORS OF EUROPE.—(*Gant.*)

OPERATOR.	PERCENTAGE PER- MANENT CURES.
Kocher.....	28.5
Von Bergmann.....	17.4
Küster.....	16.8
Krönlein.....	16.0
Czerny.....	14.6
Kraske.....	13.7
Hochenegg.....	12.9
Madelung.....	11.3
Mikulicz.....	9.7

STRICTURE OF THE RECTUM.

A narrowing of the bowel due to previous inflammation or ulceration, and characterized by pain and disturbances of defecation.

There are many varieties; the most simple and practical classification, however, is into (*a*) malignant and (*b*) non-malignant.

The condition is more common in women and is very frequent in negroes. A very practical classification, from an etiologic standpoint is into: (1) Congenital; (2) traumatic; (3) venereal; (4) spasmodic; (5) catarrhal; (6) tuberculous; (7) varicose; (8) pressure of diseased organs and tumors on the rectum; (9) valvular and band-like (*Gant*).

Congenital strictures and atresia ani are rare, but are easily recognized; they may be associated with diarrhea of frequent, small, slimy discharges. They are

usually near the muco-cutaneous margin, though occasionally they may exist as small sinuses considerably higher. The bowel above the constriction may be greatly dilated and the abdomen tympanitic.

Traumatic Stricture.—Trauma is a frequent cause as a sequence of protracted labor, misapplied pessaries, forceps deliveries, etc.

Venereal stricture is the most common. Syphilis is the most frequent cause; gonorrhea is rarely an etiologic factor. Cooper and Edwards claim that a syphilitic history can be obtained in every case of benign stricture.

Some idea of the relative significance of the etiologic factors may be gained from the following table (Cripps¹):

Syphilis.....	13
Childbirth.....	8
Operations for hemorrhoids.....	8
Operations for fistula.....	2
Congenital.....	2
Inflammation of the bowels.....	2
Internal fistula.....	2
Dysentery.....	2
Tuberculous disease.....	1
Unassigned.....	30
Total (7 males, 63 females).....	70

Spasmodic or phantom stricture may result from muscular spasm. As Gant observes, "the rectal valves have been frequently confused with this condition."

Catarrhal inflammation of long standing may give rise to ulceration. This is followed by the formation of cicatricial tissue which infiltrates the wall and subsequently contracts to an obstructive degree.

Tuberculous stricture is excessively rare, not because of the infrequency of tuberculosis in this region, but on account of the inability of tuberculous ulcers to undergo repair and develop sufficient connective tissue for contraction (Fig. 701). Caird reports an interesting case (Fig. 701). The treatment is by excision of the tuberculous portion, if circumscribed, the same as for malignant disease. The period of healing is extremely slow and results are unsatisfactory.

Varicose strictures are not common.

Pressure from without, such, for instance, as that from a retroverted uterus, fibromyoma, intraligamentous cysts, pelvic exudates, or post-proctéal dermoids, may produce occlusion of the lumen, without a mural constriction.

Valvular and band-like constrictions of the rectum may be either single or multiple and occur without erosion of the mucosa and without evidence of previous inflammatory condition (Figs. 703, 704). They form like a diaphragm in the submucous connective tissue, tending to contract to almost complete occlusion. The same pathologic condition is observed higher up in the alimentary tract. After segmental resections of the bowel, this tendency to stenosis is common.

Symptoms.—There are no symptoms in the beginning, as a rule; the first manifestations occur when the stenosis is sufficient to produce a coprostasis, as

¹ Cripps, H.: "Dis. Rectum and Anus."

shown by intractable obstipation. As the stenosis becomes more marked, diarrhea and tenesmus develop. Pain is generally of a bearing-down character. The diagnosis may be made by digital examination or by the proctoscope.

Treatment.—Treatment will naturally depend on the etiologic factors and the type of contraction.

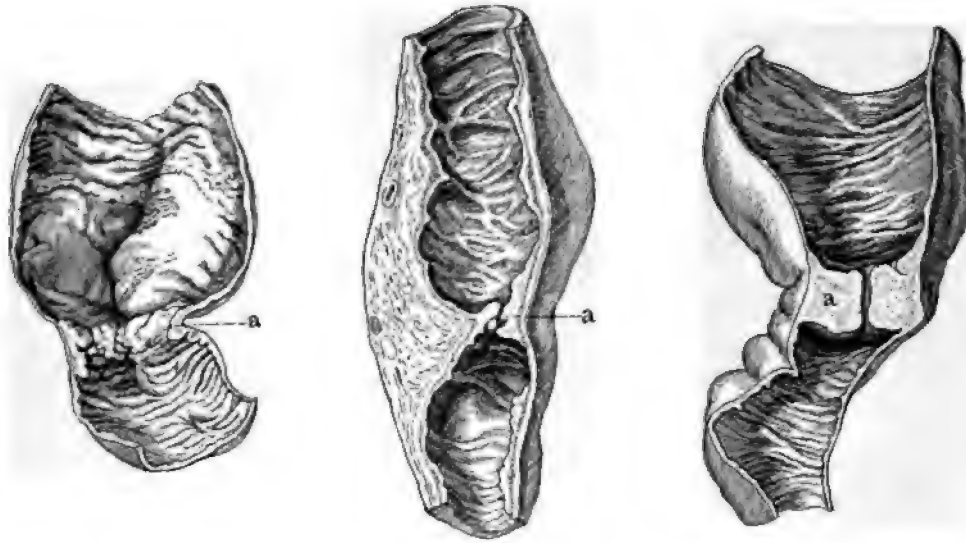


FIG. 701.—STRICTURE OF ILEUM OF TUBERCULOUS ORIGIN (after Caird).
a, Seat of stricture.

Dilatation.—In annular or short tubular strictures of post-inflammatory origin the condition may be relieved by gradual dilatation with bougies of hour-glass shape; also, massage to favor absorption of the cicatricial tissue. The bougie should remain in place for hours at a time, even when the patient is walking about.

It should not be used when there is tuberculous disease of the rectum. If this palliative treatment fails, operative measures must be resorted to.

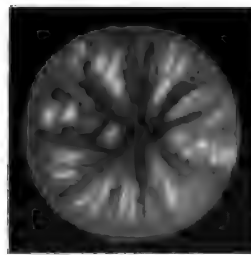


FIG. 702. PROCTOSCOPIC VIEW IN A CASE OF STRICTURE OF THE RECTUM.

Bacon's method of operating consists in excluding the stricture from the fecal circuit. The abdomen is opened and the sigmoid is folded over upon the rectum below the site of the stricture. A side-to-side approximation is then made with the button between the sigmoid and the rectum below the stricture. The male half is introduced through the sigmoid, the female half through the anus by a special trocar, which serves two purposes: (1) to perforate the wall of the rectum; and (2) to hold the button. The spur between the two segments of bowel is subsequently destroyed by a clamp on the Dupuytren principle (Figs. 705, 706).

For strictures located just above the internal sphincter this author advises per-

forating the mucosa on the posterior wall by an aneurism needle threaded with silk, and introduced from within the lumen. The needle is then carried backward as well as upward in the periproctæal tissue, thus encircling the stricture. The free ends are tied and the ligature left in place about three months. The tissues are then divided with the cautery. The cauterized tissues will not unite, thus preventing the recurrence of the stricture. Bacon cites several cases as "apparently cured," and three "partial failures."



FIG. 703.—STRICTURE OF RECTUM.
a, Cicatricial band in rectal wall; b, dilatation above the sphincter.

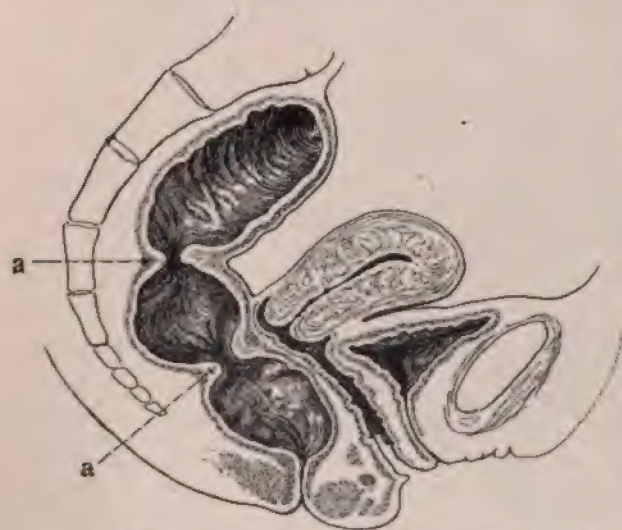


FIG. 704.—MULTIPLE STRICTURES OF INTESTINE (a, a).

Hartmann¹ advocates excision of the segment of the rectum and suture of the remaining segment to the skin.

Sigmoidorectostomy was first described by Rotter,² and by Ries³ later on and independently. After opening the abdomen the sigmoid is ligated in two places and divided between by the cautery; the distal end is closed and the proximal end protected by gauze. After placing the patient in the lithotomy position, the rec-

¹ Hartmann: Op. cit.

² Rotter, J.: "Die Sigmoido-Rectostomie, ein neues Verfahren zur Beiseitigung von Mastdarmstricturen," *Archiv f. klin. Chir.*, 1899, lviil, 334.

³ Ries, Emil: "The Treatment of Extensive Rectal Strictures," *N. Y. Med. Jour.*, 1902, lxxvi, 1028.

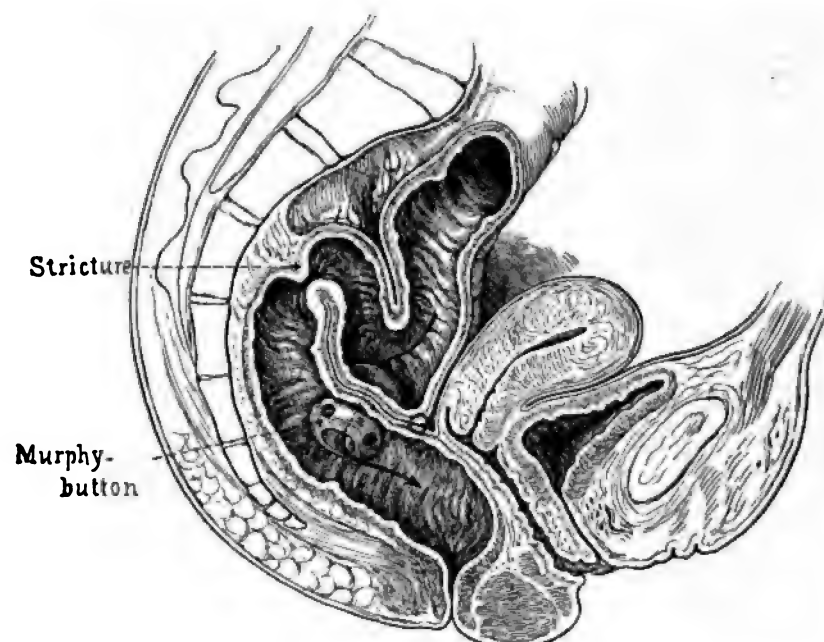


FIG. 705.—BACON'S METHOD FOR STRICTURE OF RECTUM.

to vaginal septum is incised and the bowel drawn through; the abdominal wound is then closed. The anterior rectal wall is now opened between the sphincter and the stricture, and the bowel sutured in the opening by apposing the mucous edges.

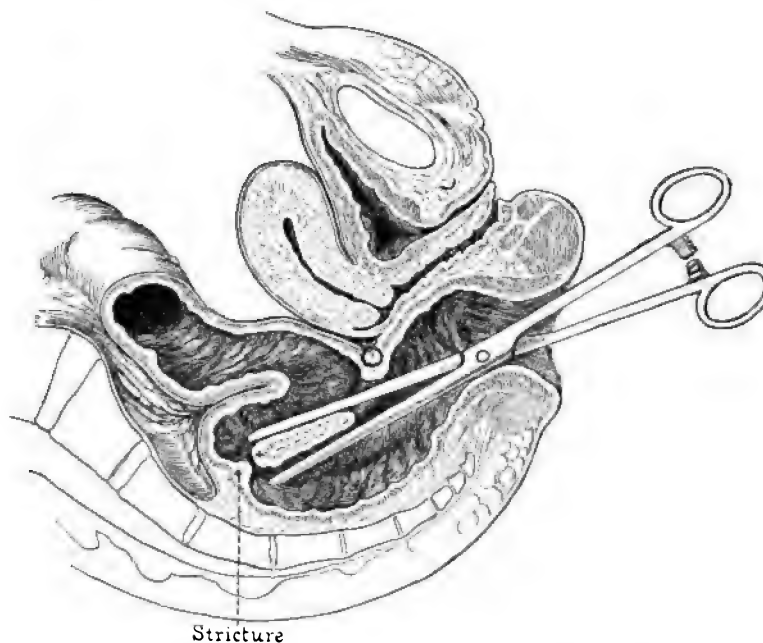


FIG. 706.—BACON'S METHOD FOR STRICTURE OF THE RECTUM.
Dupuytren's clamps applied to septum.

Sacral coloproctostomy is an osteoplastic procedure. The rectum is exposed by dividing soft tissues and bone. Once the rectum is exposed it may be treated in the same manner as Bacon's method of proctotomy.

In all operations for stricture of the rectum an efficient sphincter should be retained. Furthermore, when exsection is practised a large strip of rectum must be removed, so that the sigmoid can be utilized to replace the rectum. After removing narrow areas of the rectum the results are very unsatisfactory, there being a recurrence of the stricture at the site of suture. In the anatomic construction of the rectum there is a dense connective-tissue coat; the sigmoid, having less of this, is not so disposed to subsequent contraction. When the rectum is exposed by Kraske's method, the removal of a few inches more of bowel adds nothing to the danger, while the substitution of the sigmoid adds greatly to the ultimate success of the procedure. Insufficient excision is generally the cause of recurrence of strictures after operation.

FISTULA IN ANO.

Fistula in ano may be complete, incomplete (internal, external), complicated, or complex (Fig. 707). Another classification of great importance from an operative standpoint is fistulæ central to the sphincter and those peripheral to it.

A complete fistula is one in which there is a communication between the skin and the rectal mucosa. In the incomplete variety either a canal starts from the mucosa and ends blindly near the skin (internal blind), or it starts from the skin and ends near the mucosa (external blind fistula). The complicated or complex variety is where there are many sinuses and many external openings, with, as a rule, only one internal opening.

These abscesses result from: (1) Infection of the proctæal folds or anal valves, with or without incarcerated foreign bodies; (2) infection of the hemorrhoidal veins; (3) tuberculous and specific ulcers; (4) peri-proctæal dermoids; (5) peri-proctæal suppuration from lymphatic infections arising in the rectal mucosa; (6) peri-anal infections extending upward; (7) trauma.

As the rectal contents are always under tension, with gas or fecal accumulations, and as these tissues are constantly in motion, and in a favored location for continued sepsis, once openings are made they are slow to heal and fistulæ result. The tuberculous fistula may be either primary or secondary to a pulmonary lesion; the latter is very common. Allingham¹ estimates it to represent 10 to 14 per cent. of the patients with fistula in ano. Of 1632 cases, 234 had antecedent pulmonary lesions. Gant



FIG. 707.—RECTAL FISTULÆ.
a, Blind external; b, blind internal; c, complete, complicated.

¹ Allingham: Op. cit.

had a similar experience. The patency of the fistula may be established either by a probe or by the injection of a weak solution of methylene-blue.

Symptoms.—The initial symptoms are those of a circumscribed phlegmon with a subsequent discharge of pus either from the rectum or from some point on the buttocks. Pain is not a prominent symptom, except just preceding the rupture of the abscess. When the opening is on the cutaneous surface, the skin is inflamed, and there is more or less pruritus. In the complete variety flatus and feces often escape through the opening. In the course of time there may be incontinence and wasting; occasionally hemorrhage.

A fistula in ano rarely heals spontaneously. This is due to: (a) Imperfect drainage; (b) impossibility of rest to the part (an essential factor for repair); (c) continued supply of infective material from the feces.

Treatment.—Preventive treatment consists in the early and thorough drainage of all peri-proctal inflammatory foci. Palliative treatment, though of little benefit, may have to be resorted to, as in

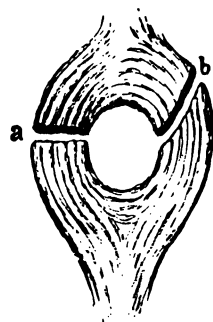


FIG. 708.—METHOD OF INCISING THE SPHINCTER.
a, Correct way, transverse; b, wrong way, oblique.



FIG. 709.—TECHNIC OF REPAIR OF FISTULA IN ANO.
g, d, Grooved director inserted in fistula; s, sphincter;
f, finger in rectum.

the case of patients who decline intervention or whose condition precludes this.

Operative.—General or local anesthesia, preferably the latter. Of first rank is the sterile water anesthesia of Gant; the various analgesic solutions may be effectively used.

Incision.—After a thorough preparation of the field of operation, the patient is placed in the lateral decubitus and the fistula incised along a grooved director. In case the openings do not correspond, Tuttle first opens the tract laterally, external to the sphincter until its fibers stand out at right angles. The sinus, after being incised, should be packed and allowed to heal by granulation. All divisions of the sphincter should be transverse and not oblique (Figs. 708, 709).

Incision with Closure.—This method consists in excising the fistulous tract, after which the deeper structures and mucous margins are approximated with catgut, and the skin with silkworm-gut or horsehair (Fig. 710).

Injection.—If the fistula be situated outside the internal sphincter, Goodsall and Miles advocate an injection of a 6 per cent. solution of nitrate of silver, the rectum being first protected by an enema of olive oil. The injections are repeated, if necessary, three or four times, at intervals of two to three weeks.

Dilatation.—The fistulous tract is gradually dilated, after which silver nitrate, zinc chlorid, or carbolic acid is applied. Healing takes place by granulation.

Thermocautery.—The Paquelin cautery may be used in place of the zinc chlorid or the nitrate of silver; it is especially applicable in the tuberculous variety.

Ligature.—This method is not to be recommended. It is based on the principle of pressure necrosis by an elastic ligature, but is slow, painful, and presents no advantages over the methods of incision, excision, or cauterization.

Sequelæ of Operations for Fistulæ.—The principal ones are: (a) Incontinence of feces; (b) incontinence of flatus; (c) prolapse; (d) continuous ulceration.

These results come from—first, deep division of the sphincter, with failure of reunion of its ends, which leaves a deep groove, often uncovered by epithelial cells, through which gas and feces leak; second, multiple divisions of the sphincter



FIG. 710.—SHOWING METHOD OF INSERTION OF DEEP AND SUPERFICIAL SUTURES.

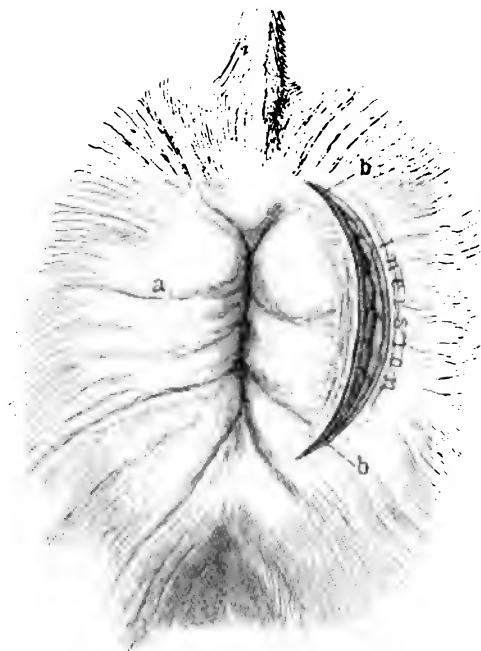


FIG. 711.—MAYO ROBSON'S OPERATION FOR INCONTINENCE OF FECES.

a, Anal margin; b, sphincter zone.

leave multiple grooves and occasionally paralysis and atrophy of the individual

sphincteric segments. In the tuberculous fistulæ there is rarely any effort at cicatrization or healing unless chemical, thermal, or mechanical removal of the granulations has been effected. The types of operations should never be performed which tend to sphincteric incapacity, as fecal incontinence and open ulcers are much more annoying to the patient than the fistula.

Repair in Case of Incontinence.—If after an operation for fistula incontinence is present, it may be relieved by many methods of repair. The one suggested by Mayo Robson¹ is easy of application (Figs. 711, 712) and gives fairly good results.

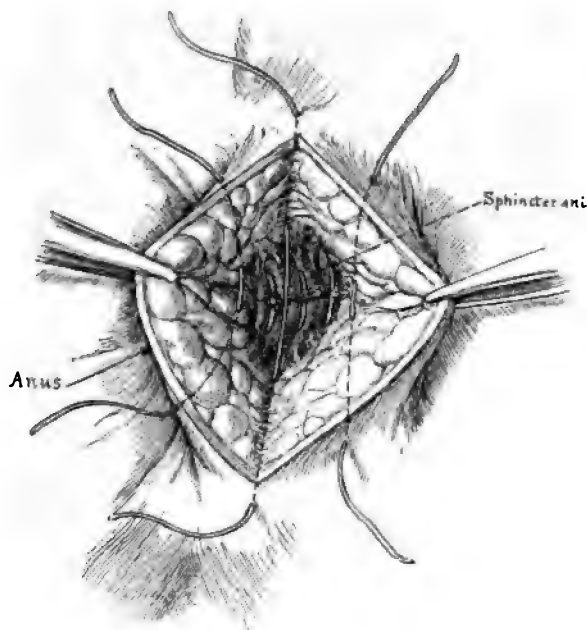


FIG. 712.—MAYO ROBSON'S OPERATION FOR INCONTINENCE OF FECES.
Method of suture insertion.

It consists in making a semi-lunar incision about the anus at the muco-cutaneous junction, from $\frac{1}{4}$ to $\frac{1}{2}$ inch in depth. This should be carried deep enough to expose the sphincter at each end. The muco-cutaneous flap is then displaced centrally and the ends of the sphincter united with the deep sutures. The skin incision is closed by horsehair or silkworm-gut and the field of operation protected from infection by collodion.

Another way is to make a V-shaped incision with the apex at the skin and the base toward the mucosa, but not incising the latter. In this way the mucosa prevents the access of infection from with-

in the bowel. The divided margins of the sphincter are freshened and approximated with kangaroo tendon or chromoform-gut sutures.

PROLAPSUS RECTI.

By this we understand a protrusion of the rectum through the anus; it may consist of the mucous coat alone or all the coats may be involved. The term "prolapsus ani," though frequently used, is incorrect, since the anus is merely an opening.

The etiologic factors vary in children and adults. In the former class of patients diarrhea, constipation, phimosis, whooping-cough, and inanition are the usual etiologic factors. In adults chronic constipation, proctitis and peri-proctitis, enlarged prostate, tumors of the bladder, rectum, and vagina, and lacerations of the

¹ Robson, Mayo: "An Operation for Incontinence of Feces Due to Relaxed or Paralyzed Sphincter Ani," *Practitioner*, Feb., 1903.

perineum are the most common causes. Prolapse of the rectum may also form part of a general prolapse of the pelvic organs. Relaxation of the levator ani or sphincter muscle, once started, is continually overtaxed by the intra-abdominal pressure; once started, protrusion of the rectal mucosa acts as a colpeurynter in destroying the sphincteric tension.

Pathology.—The prolapsed peri-proctéal tissues become atrophied in time. The bowel, being exposed to constant irritation, becomes inflamed and may finally ulcerate. The prolapse may include the sigmoid, descending colon, and even a loop of the small intestine. Partial prolapse is more common in childhood (Fig. 714); complete prolapse—of all the coats—is more frequent in adults (Figs. 715, 716). Invagination of the colon and sigmoid into the prolapsed rectum is not uncommon; Leichtenstern collected no less than two hundred and twenty cases. In forty-one of these the tumor protruded through the anus, and in thirty-one it could be palpated in the rectum.

The **diagnosis**, as a rule, presents no difficulty. Occasionally, however, a prolapse of small size may be mistaken for a polypus or hemorrhoids, and, when the protrusion is ulcerated, it may be interpreted as a malignant growth.

In addition to the unpleasant sensations from contact of the mucosa with the clothing, etc., the burning and pain are almost intolerable. The protrusion may attain a great size—from 3 to 14 inches in diameter.

Treatment.—In partial prolapse *Van Buren's*¹ *cauterization method* is an advisable one. The patient is placed in the knee-elbow or knee-chest position and the prolapse is reduced. Three or four longitudinal eschars are then burned deep with a cautery along the mucosa down to the muco-cutaneous junction. The disadvantage of this method is that the sphincter may remain permanently relaxed.

In complete prolapse a number of procedures are available, among them are: *Lange's Method.*—The patient is placed in the knee-chest position. The posterior wall of the rectum is incised from the lower part of the sacrum to the anus and all of the coccyx is removed. Then catgut sutures are passed longitudinally near

¹ Van Buren, W. H.: "Diseases of the Rectum," New York, 1881.



FIG. 713.—CONGENITAL PROLAPSUS RECTI; COMPLETE PROCIDENTIA.

the median line, and through the muscularis only, in this way infolding the posterior wall of the rectum; with a second row of sutures the lateral walls are brought into

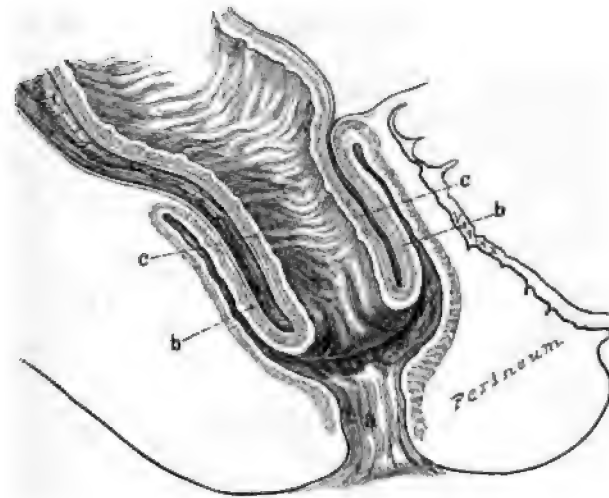


FIG. 714.—PROLAPSUS RECTI.

Partial rectal paralysis; anal zone normal. *a*, Anus; *b*, outer wall of bowel; *c*, inner wall of bowel.

apposition, thus burying the longitudinal sutures and enfolding the wall of the rectum still farther. The levator ani and sphincter which were divided are now sutured and a small tube is inserted in the rectum (Figs. 718, 719, 720).

Roberts' Method (Fig. 721). — The patient is placed in the lithotomy position and the prolapse reduced. A small incision is made in the median line of the perineum, and the finger introduced so as to free the rectum from the peri-proctæal tissue. A

scalpel is now inserted through the anus, and commencing $\frac{1}{2}$ inch to the right of the median line, an oblique incision is made through the skin and sphincter down

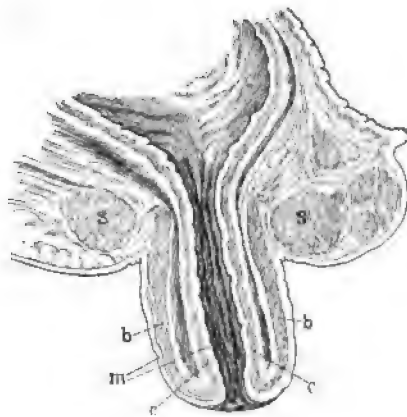


FIG. 715.—COMPLETE PROCIDENTIA (ANI ET RECTI).
FIRST DEGREE.

s, Sphincter; *b*, outer wall of bowel; *c*, inner wall of bowel; *m*, anal mucosa.

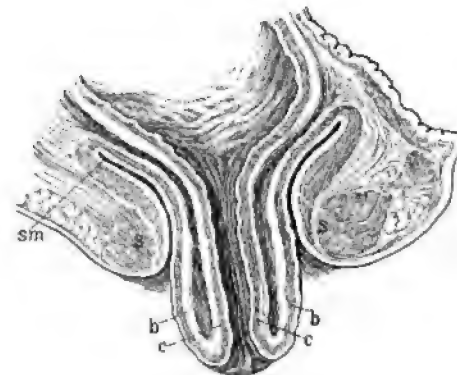


FIG. 716.—COMPLETE PROCIDENTIA, SECOND DEGREE.

s, Sphincter; *b*, outer wall of bowel; *c*, inner wall of bowel; *sm*, sphincter mucosæ.

to the first small incision. A similar incision is then made on the opposite side. The triangular piece of rectoperineal tissue is removed with the scissors; the wound

¹ Roberts, J. B.: "Note on a Method, Probably New, of Operating for Complete Prolapse of the Rectum," *Ann. Surg.*, 1890, xi, 255.

and sphincter are repaired with catgut sutures; a tube is left in the anococcygeal tissue. By following this procedure there is danger of infection, also of sacrificing a segment of the sphincter, thus hazarding the ultimate result.

Treves' Method.—With the patient in the lithotomy position the mucosa of the external wall is divided close to the anal margin. This mucous cuff is reflected downward and the bowel is divided transversely on the anterior surface, carefully protecting the peritoneal cavity. The inner tube of the bowel is divided and the circumference is grasped with forceps. The gauze is removed and the opening into the

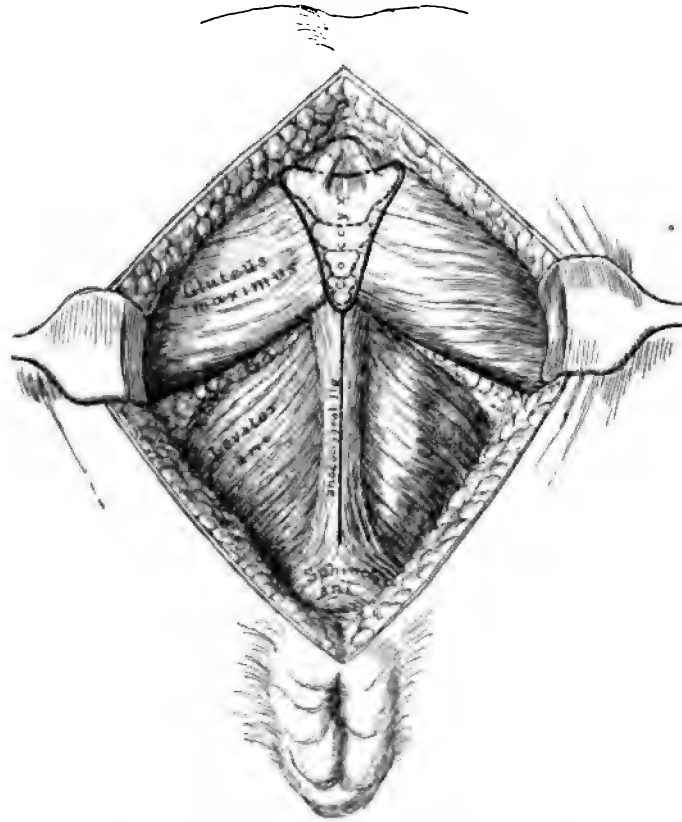


FIG. 717.—MUSCULATURE OF THE ANOCOCCYGEAL REGION.

peritoneum is closed. The edge of the divided bowel is now sutured to the anal margin of the rectum.

Mikulicz's¹ Method (Fig. 722).—An incision an inch long and parallel to the margin of the anus is made about 1 inch from the same. A stitch is passed and tied, leaving one end short; then with the other long end a continuous suture is made through the circumference of the rectum. As the suture proceeds the tube is

¹ Bogdanik (Mikulicz): "Ueber Mastdarmresektion wegen Vorfall," Arch. f. klin. Chir., 1894, xlviii, 847.

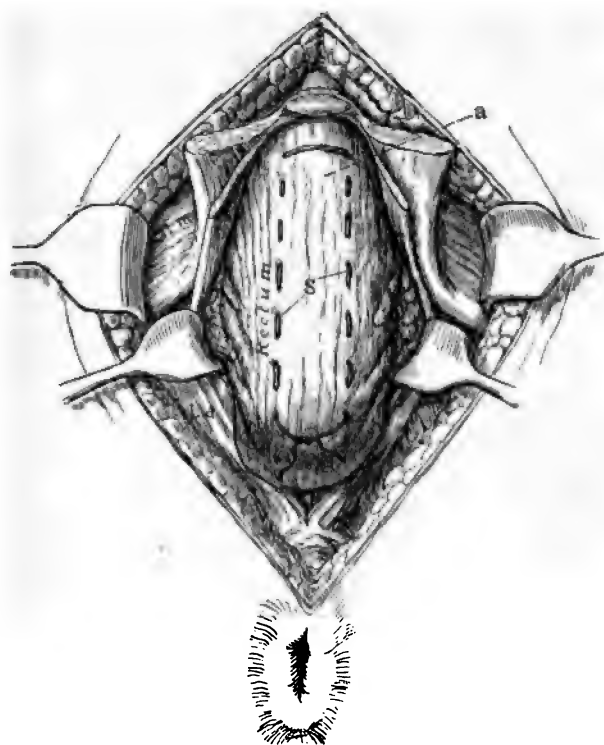


FIG. 718.—LANGE'S OPERATION FOR PROLAPSUS RECTI.
a, Posterior wall of rectum; s, line of longitudinal suture.

Verneuil's Method.—Place the patient in an exaggerated Sims position. Make a triangular flap with its base 2 inches broad, and at right angles to the tip of the coccyx, extending down to $\frac{1}{2}$ inch above the anal margin. Free this flap down to the rectum and then reflect it up. Four sutures are inserted transversely through the muscles of the rectum, and brought out $1\frac{1}{2}$ inches on the side of the median line. This is best accomplished with the eye of the needle close to the tip. The highest suture should come out on a level with the sacrococcygeal junction, and each succeed-

divided on its outer aspect, so that the suture and division are both finished at the same time.

Gant's Method, or the Wire Operation (Figs. 723, 724).—The rectum is incised longitudinally on its posterior wall and the coccyx excised. The former is then freed from its attachments throughout its circumference; a mattress of fine silver wire is then wrapped around the bowel from below upward; the bowel is replaced and the wound closed. The irritation of the wire causes firm adhesions of the gut to the anterior surface of the sacrum, and a firm deposit of connective tissue around the wire.

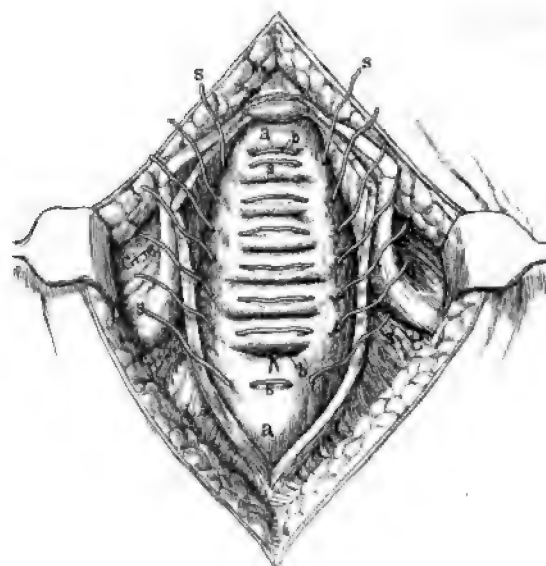


FIG. 719.—LANGE'S OPERATION FOR PROLAPSUS RECTI.
a, Posterior wall of rectum; b, longitudinal suture tied; c, transverse sutures applied.

ing one on a level with the respective coccygeal segments. The sutures are then brought taut and tied over a roll of gauze to prevent pressure necrosis. Replace the triangular flap and drain. (Priority for this operation really belongs to George R. Fowler.¹)

Gant's Operation.—A transverse incision $1\frac{1}{2}$ inches long is made just below the coccyx; the rectum is freed posteriorly and the sphincter divulsed. The bowel is pushed upward and brought into the field by a finger introduced into the rectum; a longitudinal incision is made in the posterior wall for some 2 to 4 inches, when it is transformed into a transverse one; the cut edges are now united by Lembert sutures of fine silk or catgut. By this method the bowel is shortened several inches.

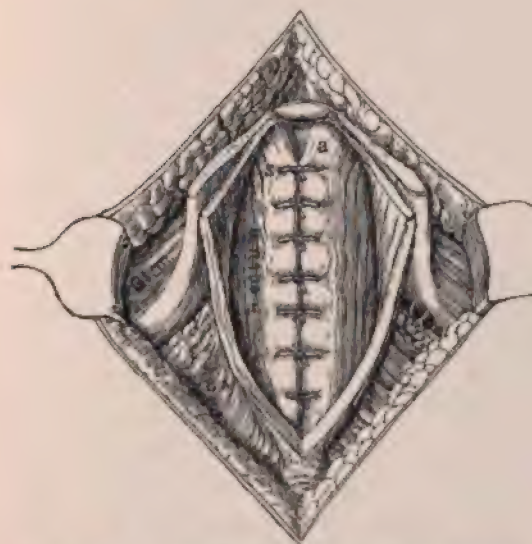


FIG. 720.—LANGE'S OPERATION FOR PROLAPSUS RECTI.
a, Posterior wall of rectum; a, transverse suture tied external to longitudinal puckering suture

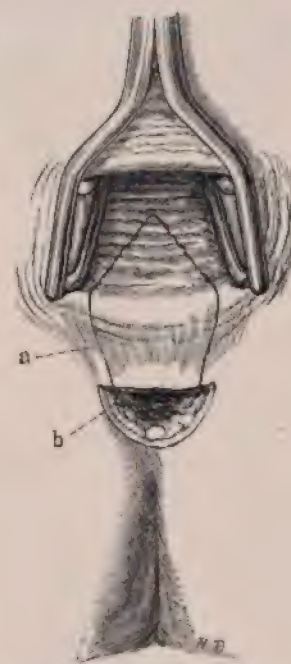


FIG. 721.—OPERATION FOR PROLAPSUS RECTI BY ROBERT'S METHOD.
a, Line of denudation; b, line of incision.

Tuttle's Method (Figs. 725, 726, 727, 728).—Place the patient in the exaggerated Sims position. Make a semicircular incision 2 inches long midway between the coccyx and the anus, extending deeply into the perirectal cellular tissue. Free the rectum from its attachments posteriorly, either with the finger or with the scissors. Curet the anterior surface of the sacrum; an assistant then invaginates the prolapsed bowel through the incision (Fig. 728). The posterior wall is cleared of fat down to the muscularis, and three to five sutures of silkworm-gut are passed transversely through this coat. Then with a long Peaslee needle the ends of the sutures

¹ Fowler, G. R.: "An Improved Technic in Amputation of Large Rectal Prolapse," *Medical News*, 1900, lxxvii, 879.

² Tuttle, J. P.: "Diseases of the Rectum, Anus and Pelvic Colon," New York, 1905.

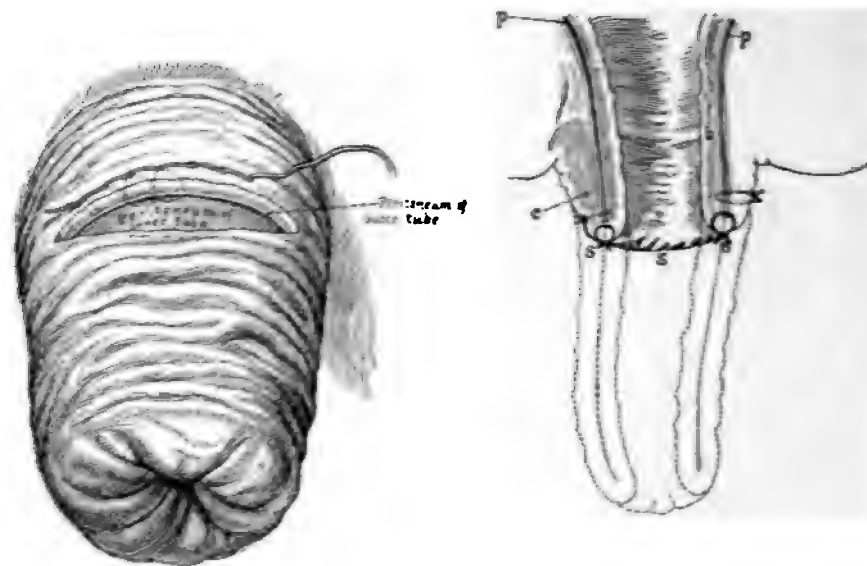


FIG. 722.—THE LINE OF AMPUTATION AND METHOD OF SUTURE IN MIKULICZ'S OPERATION FOR PROLAPSUS RECTI.
p, p, Peritoneal cavity; *b*, inner wall of intestine; *c*, outer wall of intestine; *s. s.*, line of suture.

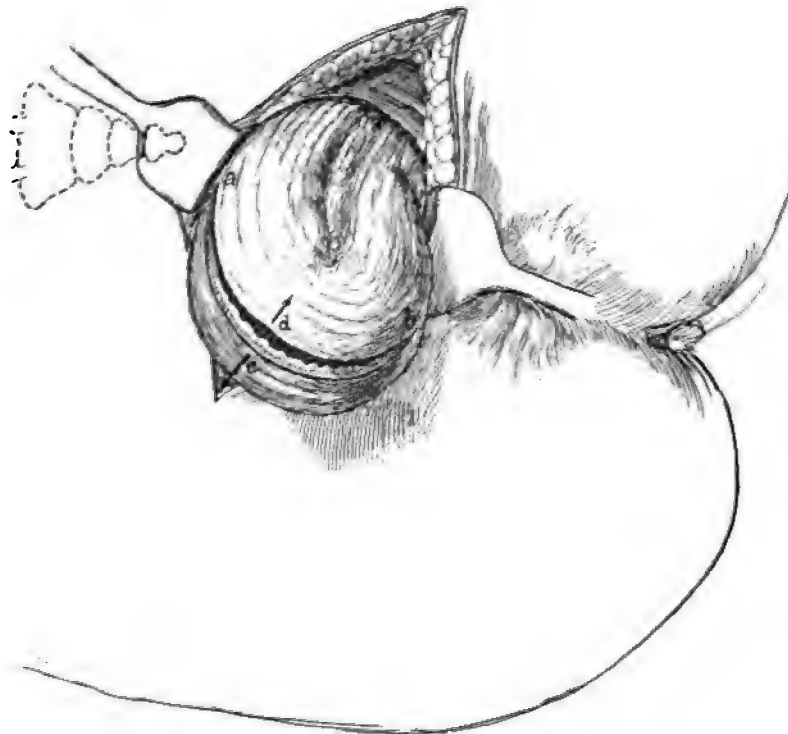


FIG. 723.—SHOWING GANT'S OPERATION FOR PROLAPSUS RECTI.
a, b, d, Represents line of incision in the posterior wall of the rectum.

are carried through the rectum and the sacral margin, and brought out on the skin on each side of the sacrum. The sutures are then tied over a pad of iodoform gauze to prevent cutting the skin. (They should be left in place for ten to fourteen days.) A buried circular suture of kangaroo tendon is passed around the rectum on a level with the upper border of the external sphincter; this should be tied tightly enough to constrict the finger introduced into the bowel. The semilunar incision is closed with deep sutures so as to repair the rectococcygeus and the sphincter muscles.

Peters' Method.—The rectum in this method is reached by a laparotomy. It is enfolded longitudinally by passing several sutures through the serous and muscular coats. The author reports a cure in a case of two years' standing.

Colopexy.—This method originated with Jeannel¹ in 1889. *Technic:* An incision is made as if for an artificial anus, and the bowel is lifted through this until the prolapse is completely reduced. The bowel is then fixed by stitches to the abdominal wall and supported by a sound wrapped in gauze. The author made an artificial anus on the sixth day, a stool occurred on the eighth day, and the sound was removed on the day following. Of thirty cases, twenty-two were cured; there was recurrence in four and partial recurrence in three. No deaths are recorded (Bryant).

Sigmoidopexy (Tuttle).—The patient being placed in the Trendelenburg position an incision is made through the left rectus and prolonged upward 2½ inches above the pubes. The parietal peritoneum is stripped on either side and the sigmoid is pulled out until the prolapse disappears. The bowel is then fixed by stitching the muscular band of the sigmoid to the wound. The author reports seven cases with no recurrences.

Murphy's Method (Figs. 729, 730, 731, 732).—The writer has devised a very effective and practicable procedure in subperitoneal sigmoid implantation. The patient is placed in the Trendelenburg position, the peritoneum is opened close to the pubis and through the outer margin of the left rectus. The sigmoid is grasped and, with the rectum, is drawn up as high as it will come with moderate traction. The posterior peritoneum is then divided from the border of the pelvis upward for a distance of 5 inches on the outer side of the ureter. The flap is next freed from its posterior attachments in an outward direction. The sigmoid is folded into the de-



FIG. 724.—LINE OF SUTURE FOR SHORTENING THE WALL OF THE RECTUM (GANT'S METHOD).

a and d are brought together and c and b are separated, giving a transverse scar, thus shortening the distance.

¹ Jeannel: (quoted) in Bryant's "Operative Surgery."

nuded peritoneal zone, and is secured to the muscles behind the peritoneum by a continuous catgut suture. The flap is then folded centralward around the sigmoid and accurately sutured to it near the mesosigmoid. The under surface of the peritoneum becomes fixed and the sigmoid in turn permanently adheres to the rectoperitoneal muscles and aponeurosis. The abdomen is then closed.



FIG. 725.—TUTTLE'S METHOD OF RECTOPEXY.
Shows line of incision for prolapsus recti. *r*, Prolapsed rectum; *i*, incision.

HEMORRHOIDS.

Hemorrhoids or piles are enlargements or varicosities of the veins in the mucosa and submucosa of the rectum, generally of mechanic origin, producing pain and constipation, and prone to inflammation, thrombosis, ulceration, and periodic bleedings.

The usual division is into external and internal hemorrhoids and cutaneous tags. The first are venous dilatations covered by skin; internal hemorrhoids are covered

by mucosa, while cutaneous tags are redundant folds of skin without enlarged veins or capillaries.

The condition is more frequent in males on account of a more erect posture. People of sedentary life are usually affected, and we invariably find a history of constipation. Pregnancy, tumors of the pelvis, or any other conditions which may obstruct the flow of blood from the pelvic veins are also etiologic factors.

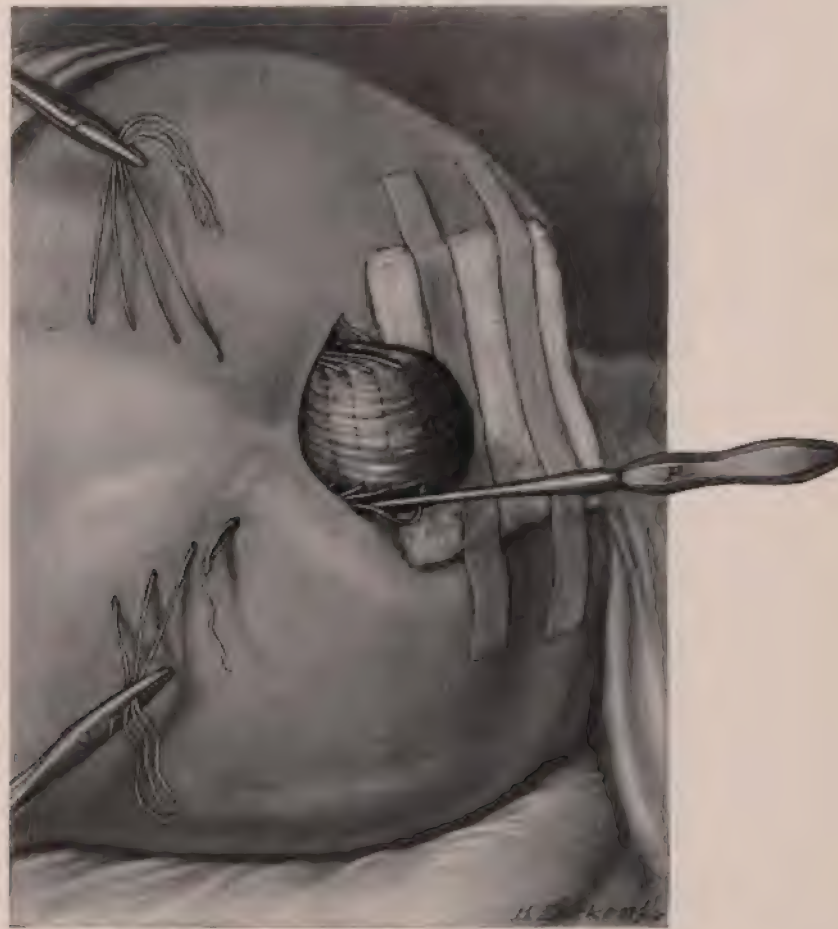


FIG. 726.—TUTTLE'S METHOD OF RECTOPEXY.

Shows Peaslee needle passing sutures around the sacrum. *R*, Rectum; *P*, curved Peaslee needle.

While pain, bleeding, and pressure are the cardinal symptoms, they are not constant.

Routes of Infection.—Before entering into the details of the operative procedures, let us consider the three principal routes of post-operative infection.

(a) The infection may invade the perirectal tissue, lead to suppuration, and even to a true ischiorectal abscess.

(b) Infection may travel along the sacrum behind the iliac vessels, up to the promontory, and infect the peritoneum, thus producing peritonitis. This type may also cause thrombosis of the internal or common iliac vein.

(c) Extension of infective phlebitis and thrombosis into the middle and superior hemorrhoidal veins, even to the portal, is not at all uncommon, and may result in pylephlebitis.



FIG. 727.—TUTTLE'S METHOD OF RECTOPEXY.

Sutures tied over gauze plug. *i*, Line of incision closed; *s*, sutures tied over gauze plug; *p*, purse-string suture around anus.

This type of infection is not sufficiently appreciated by operators; it originates in the hemorrhoidal veins through transfixion of the same by the ligature of the operator. The infection travels along the mesenteric veins, then the portal vein, and finally invades the liver, spleen, etc. The following case is illustrative:

The writer saw in consultation a patient who had been operated on for hemorrhoids five weeks previously. He was discharged from the hospital and had been walking

about for some time, when he suddenly developed irregular, recurrent chills and fever; later on icterus and some deep abdominal tenderness. There was no diarrhea and no tympany. A diagnosis of pylephlebitis was made. The patient died, and a necropsy performed by H. G. Wells, of the University of Chicago, revealed abscesses of the liver and spleen, thrombosis and suppuration of the mesenteric veins down to

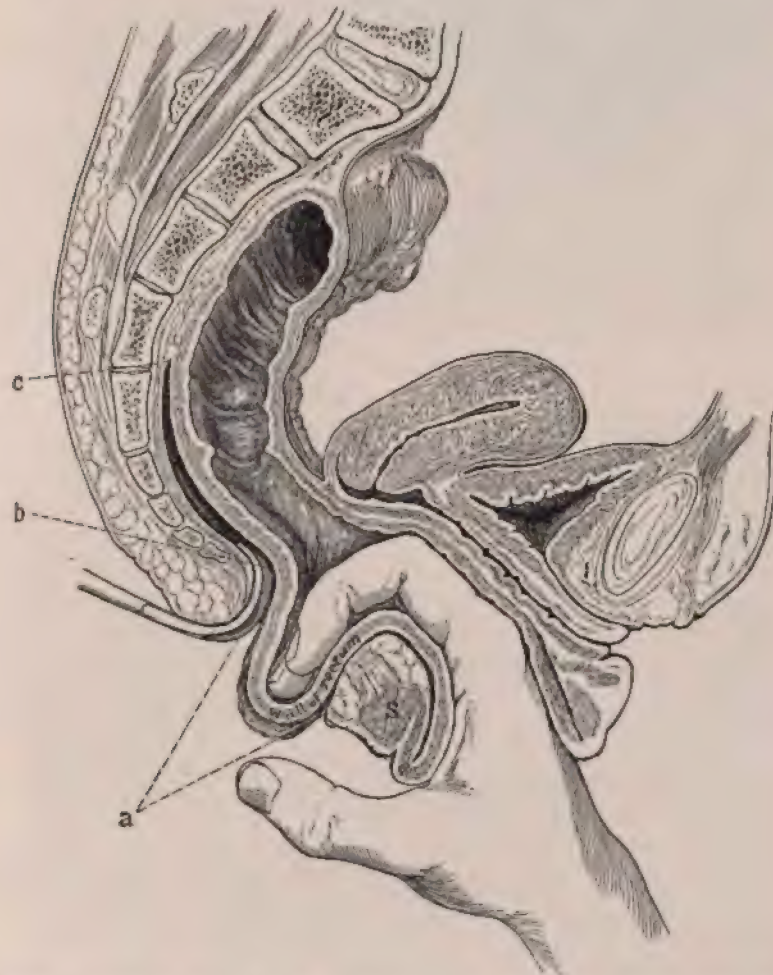


FIG. 728.—INVAGINATION OF PROLAPSED BOWEL THROUGH THE POSTERIOR INCISION (TUTTLE'S METHOD).
s, Sphincter; *a*, line of division of skin covering coccyx; *b*, *c*, shows part of rectum loosened from its posterior attachment by blunt dissection.

the point of transfixion of the hemorrhoidal vein. The infection in this case undoubtedly started from the transfixion made by the surgeon's needle, and the ligature allowed the admission of micro-organisms into the vein itself, a type of operation that should never be performed.

Methods of Treatment.—Incision and evacuation of the acute thrombus con-



FIG. 729.—LINE OF INCISION FOR SIGMOIDOPEXY (Murphy).



FIG. 730.—MURPHY'S SIGMOIDOPEXY FOR PROLAPUS RECTI.

b, b, b, Shows elevation of retroperitoneal flap and subperitoneal suture line in sigmoid.

sists in incising the dilated veins, removing the clots contained therein, and packing the cavity with gauze.

Excision with ligation is a clamping of the hemorrhoidal tumors at their base, ligation at this point, and amputation. Much pain and reflex disturbance can be avoided by splitting the cutaneous surface and peeling it backward below the line of ligation. The vitality of the stump at the point of ligation should be completely destroyed by the crushing effect of the clamp; this diminishes the subsequent pain and destroys the reflex.

Allingham's Method.—The tumors are exposed by a rectal speculum; they are then grasped one by one, dissected from their apex, and finally ligated at their base.

Whitehead's¹ Method (Figs. 733, 734, 735).—The mucosa is incised circularly at its junction with the skin; then the area containing the hemorrhoids is dissected



FIG. 731.—MURPHY'S SIGMOIDOPEXY.
a, a, a, Shows line of suture of retroperitoneum over embedded sigmoid.

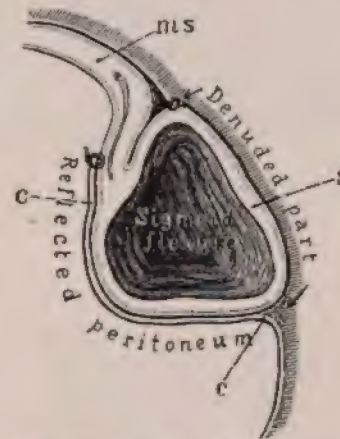


FIG. 732.—MURPHY'S SIGMOIDOPEXY.
ms, Mesosigmoid; s, wall of sigmoid; c, reflected retroperitoneal suture over bowel.

free beyond the zone of venous dilatation and above the sphincteric level. A circular amputation is made at this point; the mucosa above is freed for a short distance upward; it is then drawn down and sutured to the cutaneous margin throughout the entire circumference.

We do not indorse this method, as it is occasionally followed by stricture and pruritus. The principal objection, however, is because it removes the small zone of skin containing the papillæ, and the papillary reflex is an important element in the control of defecation. In this operation the vessels are simply twisted, not ligated. In three hundred cases Whitehead did not have a single post-operative hemorrhage. He uses carbolyzed silk ligatures.

¹ Cripps, Harrison (Whitehead, W. L.): "Prolapse of the Upper into the Lower Part of the Rectum without External Protrusion," Brit. Med. Jour., 1887, i, 447.

Earl's modification of Whitehead's operation is as follows: The hemorrhoidal dilatations are grasped and brought

down and the mucosa is incised above them. With a special forceps the veins are seized and excised, and the openings sutured over the forceps, the latter not being removed until the suturing is finished. In other words, this modification consists in removing the hemorrhoids and stitching up the mucosa without a circular resection.

Ligation.—Coates' Method.—The hemorrhoids are grasped with forceps and brought down. A clamp is then applied to the pedicle and catgut sutures passed around this are tied.

Mitchell's Method.—The hemorrhoid is clamped and amputated; a catgut suture hardened in formalin is passed beneath the upper end of the clamp and tied; one end is cut short, and with the other a continuous whip-stitch suture is made over the clamp.



FIG. 733.—FIRST STEP OF OPERATION FOR HEMORRHOIDS. Rectal speculum inserted, sphincter dilated. Hemorrhoidal tumors seen through speculum.

The clamp is then withdrawn and the suture tied.

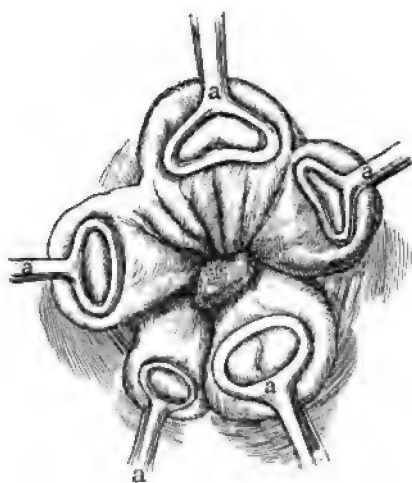


FIG. 734.—MODIFIED WHITEHEAD OPERATION FOR HEMORRHOIDS.

a, Clamp grasping individual hemorrhoids.

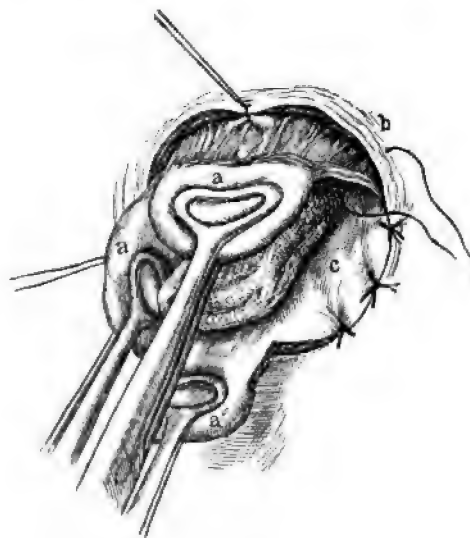


FIG. 735.—WHITEHEAD'S MODIFIED OPERATION FOR HEMORRHOIDS.

a, Hemorrhoid; b, cutaneous surface; c, mucous surface.

Mathews'¹ Method.—Tumors of small size are simply ligated. The larger ones are grasped by forceps; a silk ligature in a round needle is then passed through the base and tied, after which the tumor is excised (Fig. 736).

Ricketts' Submucous Ligature.—A needle curved to somewhat more than a semicircle is passed around the hemorrhoid in the submucous tissue. The ligature (usually a kangaroo tendon) is tied. As a result the tumors contract and disappear in a few weeks (Figs. 737, 738).

Cushing has reapplied the old method of Chassaignac, which consists in crushing the tumors with the *écraseur*. In 1880 the method was highly praised by Pollock, of London.

Chemical.—Cauterization which originated with Cusack,² of Dublin, in 1843, consists in cauterizing the pile tumors with nitric acid. This author claimed that the method was especially useful in capillary hemorrhoids.



FIG. 736.—MATHEWS' METHOD OF PARTIAL SUBCUTANEOUS AND SUBMUCOUS LIGATION OF HEMORRHOIDS WITH EXCISION (Bryant).



FIG. 737.—COMPLETE SUBMUCOUS AND SUBCUTANEOUS LIGATION OF HEMORRHOID WITHOUT EXCISION (Ricketts).



FIG. 738.—SECOND STEP OF OPERATION (Ricketts).

Hamilton advised passing needles coated with fused nitrate of silver through the hemorrhoids. (These chemical cauterization methods are not to be recommended.)

¹ Mathews, J. M.: "Diseases of the Rectum and Anus," New York, 1903.

² (Cusack) Houston, John: "An Essay on the Use of Nitric Acid as an Escharotic in Certain Forms of Hemorrhoidal Affections," Dublin Jour. Med. Sci., 1843, xxiii, 94.

Injection Method.—This seems to have originated with Mitchell, of Clinton, Ill., in 1871. Various solutions are used, but carbolic acid is the principal one. This method is very dangerous, and many deaths have been reported from its use. Among the more serious accidents following this procedure are stricture, embolism, and carbolic acid intoxication.

The American operation, which is a modification of Whitehead's method, consists in the removal of the skin all around the anus; then, after dissecting the hemorrhoids out, the mucous edges are sutured to the cutaneous margins so as to produce

a slight ectropion of the mucosa. The reasons for opposing Whitehead's operation hold good and are even accentuated in this modification. The removal of the perianal skin occasionally leads to tactile loss of sphincteric control. The injection method and the American method have been confounded by many authors.

The clamp and cautery method (Fig. 739) is one of the most simple as well as one of the most efficient for hemorrhoids. First the sphincter is forcibly dilated to a maximum degree, producing a temporary paralysis. The highest point of each hemorrhoidal tumor is then grasped; the muco-cutaneous margin is incised for $\frac{1}{2}$ inch with scissors the points of which are pushed beneath the skin and spread, thus freeing it from the hemorrhoids. The clamp is now placed on the sides of the hemorrhoids in a line radiating from the



FIG. 739.—OPERATION BY THE CLAMP METHOD.

a, Clamp on the hemorrhoidal dilatation; b, scissors applied parallel and close to the clamp, ready to cut off the hemorrhoidal dilatation; c, thermocautery.

center outward, including the hemorrhoidal vein and as much of the mucosa centralward as it is desired to remove. The clamp is closed so as not to include the skin. The hemorrhoid is excised with the scissors on the level with the clamp and the stump cauterized with the pyrography cautery previously alluded to. The clamp is then removed and the process repeated until all the tumors are excised. The skin flaps occasionally appear as tags when the healing is complete. If they are long or annoying, they may be clipped off after hydroanalgesia (Gant). They are extremely serviceable, however, in the cases of keloid tendency to stenosis.

After enumerating all these procedures it is very natural to ask which one should

be selected. In the writer's opinion, the operation of election should be either the clamp and cautery, or one in which the veins are first encircled, ligated (but not trans-fixed), and then amputated.

Sequelæ after Operations for Hemorrhoids.—Immediate, dysuria; secondary, hemorrhage; infections (peri-rectal, peritoneal, portal), erysipelas. Later, fistulæ, ulceration; fissure, stricture, and recurrence of the hemorrhoids.

Dysuria is relieved by a full dose of morphin hypodermically. Secondary hemorrhage should always be treated by ligature or suture; never by tampon or styptics.

Infection can be avoided if care be taken in (1) preparation of field of operation; (2) care of patient. A recumbent position is favorable for convalescence; it is not indispensable, however. Healing is slow and free from pain. Fistulæ and fissures do not appear if proper dressings are applied after the operation. Stricture is a sequel of the removal of too much cutaneous or submucous fibrous tissue. True recurrences after an efficient operation are very uncommon. The little tags of skin are frequently erroneously considered by the patients (and occasionally by ill-informed physicians) as a return of the hemorrhoids. The bowels should move daily after the operation.

CHAPTER XXXV.

OPERATIONS FOR DISEASES OF THE VERMIFORM APPENDIX.

By HOWARD A. KELLY, M.D., AND ELIZABETH HURDON, M.D.

APPENDICITIS.

History.—Appendicitis may be called a modern disease. Thirty years ago it was regarded with interest as a rare condition, but today it is known to be the most common abdominal affection occurring in young individuals. While, however, there was a definite increase in the number of cases during the recent large epidemics of influenza, the apparently remarkable increase in its prevalence during the last two decades is mostly due to more accurate diagnosis. For example, the statistics of the German army, which show a great increase in the number of cases of appendicitis, show a corresponding decrease in other abdominal affections.¹

Primary disease of the appendix was first clearly recognized by Mestivier,² who, in 1761, described a case of right iliac abscess which he attributed to inflammation of the appendix caused by a pin in its lumen. It was not, however, until seventy years later that, following the publications of Louyer-Villermay³ and Melier,⁴ the susceptibility of the appendix to primary disease was generally recognized; and even then, notwithstanding the clear exposition of Melier, who recognized the existence of chronic as well as acute inflammation of the appendix, the cecum was believed to be the usual source of disease of the right iliac region. During the next sixty years an appreciation of the important rôle played by the appendix in the production of many different abdominal affections, especially those of the right lower quadrant, was gradually evolved, and was finally established by the classic work of Reginald H. Fitz,⁵ published in 1886. Today there is probably no other surgical affection so well understood.

The surgical treatment of appendicitis, as it is now practised, is a development of the last twenty years. Its evolution may well be regarded as the most notable achievement of modern surgery, and with it the names of American physicians,

¹ Karrenstein: *Deutsch. Ztschr. f. Chir.*, Leipz., 1906, lxxxiv, 63.

² Mestivier: "Observations sur une tumeur située proche la région ombilicale du côté droit," etc., *Jour. de méd., chir., et phar.*, 1759, tom. 10, 441.

³ Louyer-Villermay: "Observations pour servir à l'histoire des inflammations de l'appendice du cecum," *Arch. gén. de méd.*, 1824, tom. 5, 246.

⁴ Melier: "Memoire et observation sur quelques maladies de l'appendice cecale," *Jour. gén. de méd.*, 1827, tom. 100, 317.

⁵ Fitz, R. H.: "Perforating Ulcer of the Vermiform Appendix with Special Reference to its Early Diagnosis and Treatment," *Am. Jour. Med. Sci.*, 1886, xcii, 32; "The Relation of Perforating Inflammation of the Vermiform Appendix to Perityphlitis," *N. Y. Med Jour.*, 1888, xlvii, 505.

including those of Fitz, Morton, Sands, Fowler, McBurney, Deaver, Murphy, Mynter, Morris, *et al.*, are especially associated. Incision and evacuation of right iliac abscesses had been practised from the beginning of the Christian era, but it was not until 1848 that the advisability of incising tumors in the right iliac fossa before fluctuation occurred was considered. Hancock,¹ in the year 1848, in the case of a woman with symptoms of spreading peritonitis, associated with a hard, cord-like swelling in the right iliac region, opened the abdomen and evacuated a quantity of turbid fluid and false membrane from the peritoneal cavity. Fifteen days later two fecal concretions were found in the wound, and after their removal a rapid recovery ensued. This method of treatment, however, did not come into general use until the publication in 1867 of Willard Parker's² paper emphasizing the importance of early incision and drainage. The introduction of antisepsis, the year following the publication of Parker's paper, was probably an important factor in the rapidly gained popularity of the operation, which, in the next fifteen years, reduced the mortality of perityphlitis from 47 per cent. to 15 per cent. A growing recognition that the appendix *per se* was the source of most affections of the right abdomen, and that practically all cases of so-called perityphlitis were due to appendical disease, finally led up to a further important advancement in its treatment, which, from then on, was directed to the removal of the appendix itself as the source of the disease. In 1884, Mikulicz³ advocated cutting down upon the appendix as soon as a diagnosis was tolerably certain, tying it above the seat of the perforation, and removing any concretion or decomposing material in the neighborhood. Krönlein⁴ in the same year had an opportunity of carrying out this plan of treatment and was the first to resect the appendix. In 1885, Symonds⁵ did an interval operation in a case of recurrent appendicitis, cutting down upon a small hard mass extraperitoneally and removing a concretion, but leaving the appendix *in situ*. In the year 1886 Morton⁶ successfully removed a perforated appendix, doing the first deliberately planned operation for appendicitis complicated with peritonitis. About the same time Treves⁷ successfully operated upon a case of relapsing appendicitis, but finding that he could correct the distortion, did not remove the appendix. Fitz's article, which has since become classic, cleared up the entire subject, establishing upon a sound basis the important rôle played by the appendix in the causation of right iliac disease, and urging the necessity of early operative interference. In this paper the name appendicitis was first used, the author originating the new term for

¹ Hancock: "Diseases of the Appendix Cæci cured by Operation." *Lancet*, 1848, ii, 380.

² Parker, W.: "An Operation for Disease of the Appendix vermiformis cæci," *N. Y. Med. Rec.*, 1867, ii, 25.

³ Mikulicz: "Ueber Laparatomie bei Magen- u. Darmperforation," *Sammlung. klin. Vorträge*, 1885, No. 262.

⁴ Krönlein: "Ueber die operative Behandlung der acuten diffusen jauchig-eitrigen Peritonitis," *Arch. f. klin. Chir.*, 1886, Bd. 33, 507.

⁵ Symonds: "On a case in which, at the suggestion of the late Dr. Mahomed, a calculus was removed from the vermiform appendix for the relief of recurrent typhlitis," *Lancet*, 1885, i, 895.

⁶ Morton, T. G.: "Case of Exploratory Laparotomy followed by Appropriate Remedial Operation," *Trans. Coll. Phys. and Surg. Phila.*, 1887.

⁷ Treves, F.: "Relapsing Typhlitis Treated by Operation," *Med. and Chir. Trans., London*, 1888, vol. lxxi, 165; *Lancet*, 1888, i, 527.

the purpose of calling attention to appendical inflammation as the primary lesion and of discouraging the prevailing view that the cecum was involved to any extent. From this time onward the view that appendicitis was a surgical disease from its very inception gradually gained ground, and is now generally accepted.



FIG. 740. — ABNORMAL POSITION OF THE APPENDIX.

The cecum and the proximal part of the appendix have become adherent to the posterior abdominal wall before their descent into the right iliac fossa.

Anatomy and Physiology.—A study of the embryology of the appendix shows it to be, both structurally and morphologically, merely a part of the general cecal pouch which has remained in an early stage of development. In the adult it appears

as a worm-like appendage continuous with the cecum, averaging 8.5 cm. in length and with a generally uniform diameter of 6 mm. Marked variations in length, however, are noted, some appendices being less than 1 cm., others 30 cm. or more in length.

It possesses an outer longitudinal and an inner circular muscular coat, a well-developed submucosa, and a mucous membrane. In young individuals the mucous membrane is conspicuously rich in lymphoid tissue, while its epithelium is largely composed of goblet cells. In older persons the lymph-follicles are smaller and fewer in number, and, as a rule, retrogressive changes are pronounced throughout the entire organ. In a considerable percentage of cases the tip is obliterated and sclerotic changes are marked in the submucosa and in the vessel walls.

The vascular supply of the appendix is usually derived from the ileocolic or the posterior ileocecal artery. In a few cases it comes from the anterior ileocecal artery. The peritoneal reflection containing the blood-vessels forms the mesappendix. The main veins for the most part empty directly into the portal system, and by way of small collateral channels described by Retzius and Sappey an indirect communication with the general systemic circulation may also exist.

The lymphatics of the appendix drain into the glands of the ileocolic angle.

The question of the function of the appendix possesses considerable interest now that so large a portion of the population is being deprived of this organ in early life. That it is actively functioning, in early life at least, is evident from its structure, but there is no convincing evidence to be obtained from a study of its structure or its physiologic activity, or

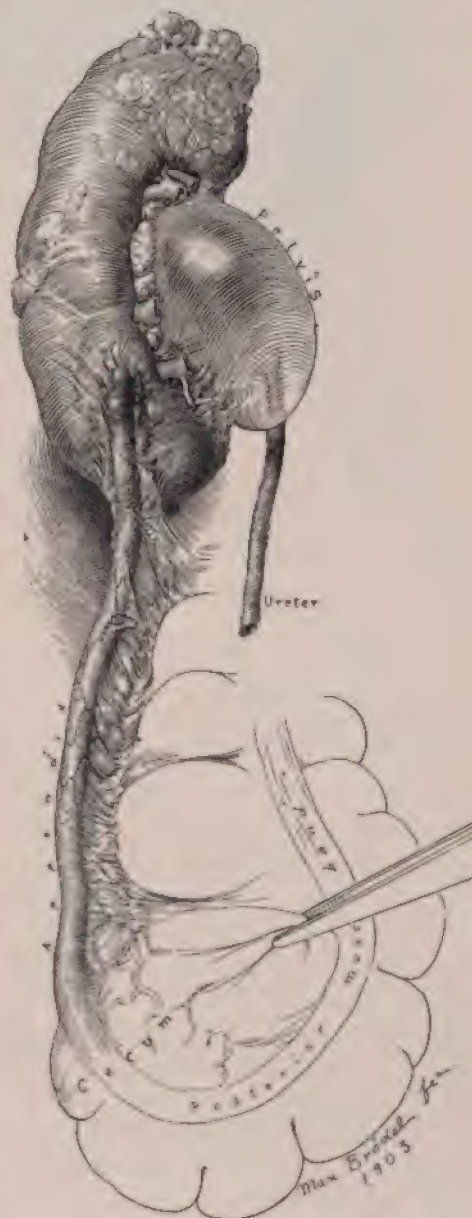


FIG. 741.—RETROCOLIC APPENDIX WITH ITS TIP HELD ADHERENT TO THE LOWER POLE OF THE KIDNEY.

from analogy, to show that it has a specific function of its own distinct from that of the cecum. Macewen's¹ interesting observations prove that the appendix pours out an abundant alkaline secretion, which Pawlow suggests may be of the nature of an enterokinase. It is a favorable medium for the growth of intestinal flora, a superabundant growth, however, being probably controlled by the lymph elements.

Topography.—A definite appendix is visible about the end of the eighth week of intrauterine life, just before the intestine recedes into the abdomen. Within the abdomen the cecum and appendix at first lie near the umbilicus, while the entire large intestine lies to the left of the median line. In the course of the normal rotation of the intestine the cecum and appendix are then pushed upward, anterior to the duodenum, until they lie just beneath the liver near the middle line, then gradually move toward the right hypochondriac region, and at about three to four months lie immediately anterior to the right kidney. From about the fourth to the seventh month, sometimes not until birth, the cecum and appendix gradually descend into their final position in the right iliac fossa. If, however, during rotation and descent, any part of the ileocecal apparatus becomes adherent to neighboring structures, it may not reach the iliac fossa, but remains in the right upper quadrant, attached to the kidney, gall-bladder, or some other structure in its vicinity. In rare instances the normal rotation and the development of the ascending colon fail to take place, and the cecum and appendix may be found in the mid-line of the abdomen or entirely in the left side.

The location of the point of origin of the appendix depends upon the topography of the cecum. Two main locations, however, are recognized: (a) behind, and (b) in front of the lower margin of the cecum. The development of these positions depends upon the time at which the mesocolon fuses with the posterior abdominal wall; early fusion, the subsequent descent of the cecum then affecting mainly the lateral and anterior portions, producing the first form, and late fusion the second. The first position is by far the most frequent, Treves placing it at 90 per cent. If the point of origin is retrocecal, the appendix may be either intraperitoneal or extraperitoneal, according as the level of the peritoneal reflection is above or below it. If it is above, the appendix usually occupies a retrocolic or retrocecal pocket. The prececal appendix is always intraperitoneal, and usually hangs directly downward or is freely movable among the coils of small intestine. In case of disease the prececal position is especially dangerous, whereas the retrocecal appendix is most favorably placed for the isolation of the infective process.

The appendix may point in almost any direction, but most frequently it is hidden behind the cecum. The most common positions and their relative frequency are approximately as follows:

Behind the ileocecal junction.....	about 40 per cent.
Ascending vertically behind or lateral to the cecum and colon.....	25 to 30 per cent.
Descending or pelvic.....	25 to 30 per cent.

An important feature in the topographic anatomy of the appendical region is the

¹ Macewen, Sir William: "The Function of the Appendix and Cæcum," *Lancet*, 1906, i.

presence of the various peritoneal folds and pockets. They may be divided into the prececal and retrocecal or subcecal folds and pockets. The former lie in front of and to the left of the cecum and include the ileocolic and ileocecal folds and the mesappendix, separating the ileocolic, superior and inferior ileocecal fossæ; the latter, situated behind the cecum, form the internal and external retrocecal fossæ and the retrocolic fossa. The appendix is often hidden in one of these pockets.

Pathology.—The diseases which may attack the appendix are: *simple inflammation, specific infections, new-growths.*

Inflammatory affections of the appendix may be divided into acute, chronic, and residual conditions. The infective process may be limited to the appendix, may spread to the general peritoneum, or may produce a metastatic or general infection.

Acute appendicitis in practically all cases is characterized by a diffuse inflammation of all the tissues of the appendical walls. The disease is rarely limited to the inner coats. The organ in the early stages of the attack is turgid, injected, and slightly rigid; the superficial vessels are dilated and tortuous; the peritoneal surface is usually diffusely reddened, sometimes appears finely granular, and may be flecked with a serofibrinous or fibrinous exudate (Fig. 743). Discolored areas of beginning gangrene and suppuration are sometimes found within the first few hours of the attack; the organ may even be completely gangrenous. Early gangrene in appendical inflammation may be due to pre-existing vascular degeneration, superimposed upon which the acute inflammatory reaction produces complete obstruction of the circulation. Perforations, of pin-point size or involving the whole circumference, take place at any period, marking the onset of symptoms or occurring during the apparent subsidence of the attack. In some of the most



FIG. 743.—ACUTE APPENDICITIS.

The whole appendix is intensely congested; the proximal third is distended with pus and at *b* shows an area of beginning gangrene. At *a* the appendix is sharply kinked and held in this position by old adhesions; the convex surface of the kink is gangrenous. (Case of G. Beck.)

rapidly fatal cases the appendix may show nothing beyond a diffuse reddening and edema of the tissues. The canal may be patulous throughout, containing merely a little mucopurulent exudate; the mucosa is swollen and injected, and minute ulcerations usually may be found. In other cases the canal is obstructed



FIG. 742.—ACUTE APPENDICITIS.

The appendix and meso-appendix are swollen and hemorrhagic. A few vascular adhesions are attached to the serosa and a hemorrhagic lobule of fat to the tip of the appendix.

near the cecum and the part beyond is distended with pus and lined with granulations or partially necrotic material. Porter¹ describes a case in which the appendix, obstructed at its origin by a concretion, was distended with pus and gas—pyopneumo-appendix.

The spread of the infective process may occur directly through the walls of the appendix or by means of a perforation, producing a circumscribed, spreading, or general peritonitis; or it may occur by way of the lymph or blood-channels through the intact walls, and cause a metastatic or general infection.

Peritonitis due to appendicitis may be serofibrinous, septic, or purulent, and may be localized, spreading, or general.

Suppurative Periappendicitis (Circumscribed Purulent Peritonitis or Periappendical Abscess).—The localization of a periappendical abscess varies according to the direction, position, and length of the appendix, whether it is intraperitoneal or extraperitoneal; and the situation of the most severe lesion in the appendix, whether in the middle, base, or tip. Not infrequently the appendix is hidden in a peritoneal pocket which is especially favorable for the walling off of the suppurative process. The natural barriers of the abdomen, as pointed out by Mikulicz, also tend to determine the direction in which the abscess may spread. The posterior abdominal wall presents three well-defined cavities in which pus is apt to collect—the right and left iliac fossæ and the pelvis. The abdomen is further divided into a supra-omental and infraomental space, the supraomental space being divided into the subphrenic and subhepatic; the diaphragmatic area being again divided by the hepatic ligament into right and left spaces. The region below the omentum is further subdivided by the mesentery of the ileum. The pelvic cavity forms the lower portion of this region.



FIG. 744.—ACUTELY INFLAMED APPENDIX LINED THROUGHOUT WITH NECROTIC MATERIAL.

At *a* and *a'* are abscess foci and at *a'''* a pinhole perforation. The mesentery (*c*) is edematous and hyperemic.

When the appendix lies behind the ileocecal junction or lateral to the cecum and ascending colon, the natural tendency of the pus is to collect in the iliac fossa and to gravitate upward as the patient lies recumbent. The upward course is facilitated by the direction of the lymph-stream. When the appendix occupies the dependent position the pus tends to pour into the pelvis. The upward extension of the suppurative process may result in a perirenal, a subhepatic, or a subphrenic abscess; its downward extension results in a superior or an inferior pelvic abscess.

¹ Porter, M. F.: "Pyopneumo-appendix due to Obstruction by a Fecal Concretion," Jour. Am. Med. Assoc., 1906, xlvii, 435.

Retroperitoneal appendical abscess usually develops when the appendix is situated behind the peritoneum, but may occur when the intraperitoneal organ is adherent to the parietes. The arrangement of the renal and hepatic fascia and ligaments favors the upward extension of the retroperitoneal iliac abscess, and it is also prone to travel down along the psoas muscle, and between the rectum and pelvic peritoneum. The abscess may be thin-walled and distinctly fluctuating, or it may consist of a small necrotic focus in the center of a dense mass of inflammatory products, resembling a new-growth, which may remain for months and may even become calcified.



FIG. 745.—ABSCESS SURROUNDING THE PROXIMAL PORTION OF THE APPENDIX. THE DISTAL HALF IS CONGESTED, BUT IS PERFECTLY FREE.

The appendical abscess may rupture into the general peritoneal cavity, into any of the hollow viscera, or through the abdominal walls. The internal or external fistula resulting from the rupture of the abscess may persist indefinitely, or may close spontaneously, and in some instances is followed by complete cure. Again, the septic process becomes arrested, the inflammatory products are absorbed, and finally only a few dense fibrous adhesions remain.

Spreading or generalized peritonitis may be divided into acute septic, serofibrinous, and purulent. Septic peritonitis is characterized by a diffuse reddening lack-luster appearance, and sometimes hemorrhagic condition of the peritoneum, and the absence of any exudate except a little bloody serum or a few flakes of fibrin.



FIG. 748.—CHRONIC APPENDICITIS.

The appendix, which was partly embedded in the posterior wall of the colon, is doubled up into a hard rounded nodule enveloped in adhesions. The section shows a fecal concretion in its lumen.



FIG. 749.—OBLITERATED APPENDIX.

At *a* the appendix is reduced to a thin fibrous cord.

opposite the mesenteric border. The condition is probably the result of an antecedent inflammatory process.

Etiology.—The causative factors which may enter into the production of an attack of appendicitis may be considered under three headings: Predisposing; exciting; and final, or essential.

Predisposing causes may be local or general. Among the most important are the normal anatomic and physiologic conditions. The mechanical conditions in the appendix are such as favor the stagnation of its contents, with a consequent increase in the virulence of the contained micro-organisms, while the presence of abundant lymph-follicles affords a portal of entry for bacteria. Klemm,¹ as the result of careful study, concludes that appendicitis is a specific disease of the lymphatic tissue, which does not differ from similar affections of other lymphatic organs. Previous attacks, with the resulting strictures, kinks, twists, and adhesions, are an important cause of subsequent attacks. Adhesions of the normal appendix to adjacent



FIG. 750.—CYSTIC APPENDIX.

The undilated proximal end of the appendix is pervious, but at its junction with the cystic portion it is completely obliterated. The surface of the cyst is injected and covered with adhesions.

structures, such as the pelvic organs, or to the site of a previous operation, also create a *locus minoris resistentiæ*. Edebohls² ascribes to the floating right kidney an important rôle in the etiology of the disease.

Age.—Appendicitis is a disease of early life, four-fifths of all cases occurring before the age of thirty, and more than half before twenty.

Exciting Causes.—Disorders of digestion are by far the most important exciting causes of an appendical attack; other factors producing a physiologic congestion, such as exposure to cold, a severe strain, or menstruation, are occasional exciting causes of recurrent appendical attacks. Trauma, especially indirect injury, is a somewhat frequent cause of an acute attack where previous disease has existed. It has not been proved that trauma ever causes inflammation in a previously normal appendix.

¹ Klemm, P.: "Ueber die Erkrank. des Lymphatischen Gewebes u. ihr Verhältniss z. Appendicitis," *Deutsche Ztschr. f. Chir.*, Leipz., 1906, lxxxvi, 427.

² Edebohls, G. M.: "The Relation of Movable Right Kidney and Appendicitis," *Am. Jour. Obst.*, 1895, 165.

Foreign bodies and concretions, which formerly were supposed to be the principal exciting causes of appendicitis, are now known to play a very subsidiary part, and are found in only a small proportion of even severe cases. Among the foreign bodies that have been found are pins, shot, pieces of bone, lead, hairs, bristles, seeds, and enterozoa. The commonest and most dangerous of these are pins and other pointed bodies, which readily enter the small appendical orifice and pass into the canal (Mitchell¹). They may remain in the canal for months, becoming encrusted with calcareous deposit and acting as a constant irritant to the appendical walls, which the point may finally penetrate. Except in appendices of the fetal type, it is impossible for light bodies such as cherry-stones and orange-seeds to pass the narrow orifice. Small seeds are commonly found, but only form part of the normal ingesta

FIG. 751.—PIN ENCRUSTED WITH CALCAREOUS MATERIAL, REMOVED FROM THE PERFORATED INFLAMED APPENDIX. (After Mitchell.)

and readily pass in and out. The enterozoa, especially the *ascaris lumbricoides* and the *oxyuris*, occasionally provoke an acute attack of appendicitis. In two cases, at least, *Bilharzia* disease has developed primarily in the appendix.² Concretions are present in a considerable proportion of perforative and gangrenous appendicitides. They play an entirely passive rôle, obstructing the lumen and causing pressure anemia of the tissues. (See Fig. 752.)

Final or Determining Causes.—Bacteriology.—Pathogenic micro-organisms always form the final or immediate cause of appendicitis. The normal flora of the appendix, innocuous when controlled by the secretions of the healthy bowel, become highly pathogenic under certain conditions. Traumatism, acute congestion, the production of a *vas clos*, angulation, or strictures, produce a *locus minoris resistentiae*, favorable to the growth of bacteria and incapable of resisting their invasion. The following are the most important micro-organisms found in inflammation of the appendix. The *bacillus coli communis* is found the most frequently, and in the majority of cases is the only organism present, but also occurs in combination with other bacteria. The *streptococcus pyogenes* can be isolated only in a minority of cases, but is of great importance in the causation of the disease, as it is especially associated with the most severe infections. Other intestinal flora more rarely found in appendical inflammation are the *bacillus pyocyaneus*, micro-



FIG. 752.—ACUTE PERFORATING APPENDICITIS IN A GIRL THREE AND ONE-HALF YEARS OLD.

The appendix, which has preserved the fetal type, has a wide funnel-shaped orifice (a). The large opening in the acutely inflamed distal portion of the appendix is choked with a fecal concretion.

¹ Mitchell, J. F.: "Foreign Bodies in the Appendix," Johns Hopkins Hosp. Bull., 1894, 35.

² Burfield, J., and Shaw, E. H.: "A Case of *Bilharzia* Infection of the Appendix," Lancet, 1906, I, 368.

coccus pyogenes, bacillus of the hog cholera group, and bacillus aërogenes capsulatus. Inflammation may also be produced by the introduction of virulent micro-organisms into the general circulation (Roger¹), propagated from an infective enteritis (Reclus²) or may be due to a descending infection from the gall-bladder (Dieulafoy³).

Appendicitis as a Local Expression of a General Infection.—Animal experimentation has demonstrated that the lymphoid tissue of the appendix is the seat of predilection for the localization of infective organisms derived from the general circulation (Adrian⁴). The clinical evidence also is convincing. The frequent association of appendicitis and tonsillitis, and of both with acute rheumatic fever, is well known; as well as the definite increase in the number of cases of appendicitis occurring during the large epidemics of influenza, and its association with other general infections; viz., measles, scarlatina, varicella, and parotitis. The relation of appendicitis to typhoid fever is probably one of direct propagation from the small intestine, rather than a blood infection. It is not determined whether the general infection merely acts as an exciting factor by preparing a suitable soil for the activities of the intestinal bacteria, or whether the specific micro-organism is the direct cause of the appendicitis. The influenza bacillus and the pneumococcus have been demonstrated in appendical abscesses in a few instances, but more observations are necessary to determine the exact relationship existing between these affections.

Symptoms and Diagnosis.—For clinical purposes appendicitis may be conveniently divided into acute, relapsing, and chronic appendicitis.

Acute appendicitis may have a sudden acute onset, or may be ushered in insidiously with slight digestive disturbances for a few days, followed by indefinite local symptoms which steadily increase in severity. The important symptoms include pain, localized tenderness, rigidity, nausea and vomiting, constitutional disturbances, distention, tumor, and ileus.

Pain.—Pain is the first and most important early symptom, and is soon followed by nausea and vomiting; increased pulse-rate and rise in temperature are usually present early, in a direct ratio to the severity of the pathologic lesion in the appendix. The initial pain may from the first be localized in the right lower abdomen, but is commonly referred to some other region, especially the umbilical or epigastric; or it may be diffused over the whole abdomen. It is usually paroxysmal, colicky, and radiating, in the beginning, but after a few hours it becomes localized in the right iliac fossa, and is then usually continuous. Acute exacerbations are brought on by any movement, especially such as involves the psoas muscle; hence the patient lies in the dorsal position, and often keeps the right thigh flexed. The pain may be confined to a very small area in the appendical region, or may radiate down into the groin, to the lumbar region, or toward the median line—sometimes causing marked retraction of the testicle. In the case of an ascending, retrocecal appendix the pain

¹ Roger: "Les Maladies Infectieuses."

² Reclus: "Pathogenie de l'appendicite," Sem. méd., 1897, 237.

³ Dieulafoy: Bull. de l'academ. de méd., Paris, 1904.

⁴ Adrian: "Die Appendicitis als Folge einer allgemeinerkrankung u. s. w.," Mitt. a. d. Grenz. des Med. u. Chir., 1901, Bd. vii, 407.

may be in the region of the gall-bladder or the right kidney; or, if the appendix hangs down over the pelvic brim, the pain may be confined to the hypogastric or to the pelvic region. Bladder and rectal tenesmus are common symptoms.

The pain lessens in intensity after a few hours, and, in a simple case, usually ceases in from twenty-four to forty-eight hours. An increase in the local infection is usually marked by the continuance and increasing intensity of the pain. A sudden sharp pain after a temporary subsidence often means a perforation or a beginning general infection. On the other hand, a sudden lull in the local symptoms, not accompanied by general improvement, is ominous of a ruptured pus sac, of gangrene, or of toxemia. If the pain again becomes generalized, spreading peritonitis may be suspected. Severe pain, or an increase in its intensity after the first few hours, usually indicates a rapidly advancing infection.

Tenderness.—Localized tenderness is the most valuable sign of early appendicitis. It is a symptom, however, which must be estimated with considerable caution, as it is apt to be exaggerated by neurotic patients. If, however, the patient's attention is diverted by engaging him in conversation, or by simultaneously placing the other hand on some other part of the body, the amount of tenderness usually can be determined accurately. Tenderness is a particularly valuable sign, as it persists after spontaneous pain has ceased and is present throughout the course of the disease. The point of maximum tenderness is usually directly over the base of the appendix, or it is over the point where the pathologic process is most marked.

Muscle spasm is a certain sign of an acute inflammatory process, but is present only during the early stages. The most active spasm is found when there is beginning peritonitis.

Rigidity.—Next to pain and tenderness, rigidity of the abdominal muscle is the most reliable early sign of acute appendicitis. At the outset it is general, but soon after the localization of the infection it becomes limited to the right side. While a valuable sign, it often disappears early and may be very slight or entirely wanting in the most serious conditions; on the other hand, pronounced rigidity may be noted in the presence of a very mild inflammatory process. In diffuse peritonitis there is general rigidity, the abdomen becoming uniformly distended, tense, and motionless, or retracted and hard. In rare instances the abdomen is soft and natural looking in the presence of a severe general peritonitis.

Fever.—Rise of temperature is a variable sign. It is usually elevated, but may be almost normal throughout, and is rarely high. With steadily increasing local symptoms during the first twenty-four hours of the attack, the temperature may not exceed 98.6° F. Increasing fever, however, is, as a rule, indicative of a severe inflammation, and a continuous high temperature after the first forty-eight hours almost always points to suppuration. Disturbance of the normal ratio between temperature and pulse is always a grave omen. A high temperature, with a full, rapid pulse-rate, is a better prognostic sign than a low temperature with a small, rapid pulse. The pulse is usually accelerated. If a pulse which has been but little

accelerated begins to go up, operation is urgently indicated, as there is either a beginning local extension of the disease or a general infection.

Tumor.—A mass in the right iliac fossa may be the result of adherent intestine, a rolled-up omentum attached to the appendix, an inflammatory exudate, or an abscess focus. A mass may be simulated by the rigidly contracted muscles over the affected area, and, on the other hand, the rigid wall may hide a tumor mass beneath. The presence of a tumor in the appendix region is an indication for early operation unless the general condition is decidedly improving and the mass is distinctly decreasing in size and tenderness. Delay is dangerous when there is persistent temperature, or when the mass is apparently stationary in size or enlarging. It is impossible to foretell at what moment the abscess may rupture into the general cavity or to detect the insidious development of secondary foci of suppuration.

Vomiting.—This is an inconstant early symptom of acute appendicitis. There may be a slight attack of vomiting at the onset of the disease, or it may occur two or three hours later and be repeated once or twice. It is never continuous in favorable cases, and usually ceases in a few hours. Persistent and uncontrollable vomiting indicates the presence of general peritonitis. *Hematemesis* has been noted in a few cases. It always indicates a severe infection.

Constipation is present in the majority of cases of acute appendicitis, but may sometimes be preceded by an attack of diarrhea. Rarely, diarrhea continues throughout the attack.

Ileus.—Persistent ileus is one of the most urgent indications for immediate operation. An ileus appearing at the very outset may be due to the violence of the attack and may quickly subside, but, when persistent, it is a sign of a spreading peritonitis with intestinal paralysis, or it arises from an obstruction of the bowel due to a kink or compression. There is constant vomiting, which finally becomes fecal; complete obstipation, after the lower bowel is emptied; the abdomen is distended; in obstructive cases peristalsis at first is marked, but finally ceases.

Chills are usually observed at the onset of septicemia and may occur at irregular intervals. They are usually accompanied by a high temperature, which may show daily remissions or intermissions. Repeated rigors with an intermittent or remittent temperature, and sweats, indicate a pyemic process; when jaundice is also present there is a pylephlebitis or a liver abscess.

Icterus developing in the course of an appendicitis may indicate a profound toxemia, or may be due to obstruction of the bile-ducts by adhesions, or to an infective hepatitis or pylephlebitis.

Leukocytosis.—The value of the leukocyte count as a diagnostic and prognostic sign is subject to considerable difference of opinion. The importance of leukocytosis in any case can be estimated only after careful consideration of all the factors which modify the blood count, and depends upon the stage of the disease at which the count is made. Early in the disease a steadily increasing leukocytosis in connection with other symptoms of appendicitis is an indication for immediate operation; later in the disease a persistently high leukocytosis of 20,000 or more is almost

always a sign of suppuration. But there may be a high leukocytosis with comparatively slight lesion; a low leukocyte count, on the other hand, may accompany the most violent infections, and is found in cases where the organism is unable to offer any resistance to the overwhelming intoxication. A moderate leukocytosis of 10,000 or 12,000 in the early stages has little practical significance, as it may be referred to a variety of conditions. In children a high leukocyte count is normal and is increased by digestion. In pregnancy the leukocytes vary from 7,000 to 13,000. An extremely high leukocytosis of 25,000 to 40,000 in the early stages should be regarded with suspicion and a thorough examination of the chest should be made. Intestinal obstruction from any cause is often accompanied by marked leukocytosis. The differential count may be of importance, especially with an apparent lull in the acute symptoms or with an exacerbation. A diminution or absence of eosinophiles at this time is very significant of a rapid extension of the local infection. A relative increase in the eosinophiles, on the other hand, is common in children suffering from intestinal disturbances caused by the presence of parasites.

In the presence of the cardinal symptoms—namely, sudden acute abdominal pain, tenderness over or near McBurney's point, and localized muscle rigidity—the diagnosis of appendicitis is justified in the majority of cases; with nausea and vomiting, elevation of temperature, and accelerated pulse-rate, the diagnosis is more positive and the presence of a tumor makes it certain. Any one or almost all of these symptoms may be absent while the disease is rapidly progressing; and, on the other hand, an apparently typical symptom-complex may be found to be due to some other abdominal or thoracic affection.

Urinalysis.—Lannelongue¹ calls attention to the greatly increased urotoxic coefficient in severe cases of appendicitis, and regards this sign as of value from the standpoint of the prognosis. The early appearance of indican in appendicitis is sometimes of value in differentiating this affection from the general infections, where it appears later.

Chronic appendicitis usually manifests itself by the presence of abdominal pain, generally located in the right side and often associated with digestive disturbances, especially constipation and flatulency. The somewhat frequent association of *mucous colitis* with chronic appendicitis and the relief obtained in some cases after removal of the appendix suggest the existence of an etiologic relationship between the two affections.

Differential Diagnosis.—The principal conditions which may be confused with appendicitis are: Diseases of the right kidney and ureter, diseases of the gall-bladder and ducts, omental and intestinal adhesions, new-growth, tuberculosis or ulcer of the cecum, tumor or inflammation of the uterine adnexa, extrauterine pregnancy, and an inflamed Meckel's diverticulum.

In women, *disease of the pelvic organs* is frequently confused with appendicitis.

¹ Lannelongue: "Toxicité urinaire dans l'appendicite," Bull. de l'acad. de méd. Paris, lxxi, Nos. 18-21.

A careful bimanual examination, with the patient under an anesthetic if necessary, will at once reveal the existence of a pelvic affection, but in making the differential diagnosis the frequent coexistence of the two affections must be constantly kept in mind.

A *floating kidney* has occasionally been mistaken for appendicitis and operation undertaken. A careful consideration of the constitutional symptoms and an examination in the standing (Noble) as well as in the dorsal position should make the diagnosis of floating kidney clear. An examination under anesthesia will be of service in definitely palpating the appendical region; but under these conditions the examiner loses the assistance afforded by the sensations of the patient under the examination.

Stone in the kidney or ureter and also *acute pyelitis* may simulate appendicitis in both the local and constitutional symptoms. The urinalysis will usually indicate the presence of an affection of the urinary tract, and then with the aid of the *x-ray* and ureteral catheterization an accurate diagnosis may be made.

With *stone in the gall-bladder* or an adherent *cholecystitis*, the local manifestations are situated in the upper quadrant and often radiate toward the scapular region, but inflammation of an ascending retrocecal appendix may give rise to exactly the same symptoms; while, on the other hand, a large empyema of the gall-bladder may form a tumor in the iliac fossa associated with pain and tenderness in this region.

Inflammation of a Meckel's diverticulum can be differentiated only by means of abdominal section. Fortunately, with few exceptions, the abdominal and pelvic affections which may be mistaken for appendicitis, in themselves call for surgical treatment, and the only question involved is the form of incision best adapted to the condition.

The differential diagnosis between *typhoid fever*, in the early stages, and appendicitis often involves the most anxious consideration, as an unnecessary operation on a typhoid case might be the direct cause of a fatal outcome. Severe right iliac pain, local tenderness, and muscular rigidity are not uncommon initial symptoms of typhoid fever. In such cases the chief reliance must be placed upon the general appearance of the patient, the character of the temperature curve, the pulse, and frequent leukocyte counts. (See p. 530.) The patient should be kept under constant observation until the diagnosis is secured.

Pneumonia, particularly in children, often begins with acute abdominal symptoms, very suggestive of appendicitis, before there are any clear thoracic symptoms. The high initial temperature in pneumonia and the rapid breathing should put one on his guard; a high early leukocytosis also speaks for pneumonia. With these symptoms the case should be carefully watched for the development of thoracic signs.

OPERATION.

Before proceeding to consider the question of operation it seems advisable to say a few words regarding the treatment of the patient until surgical aid can be secured. Cases in which operation is not deemed advisable for some important reason may be treated by the Ochsner method throughout the attack, but in all other cases it should be regarded merely as "first aid" (Coffey¹) until a surgeon can be secured.

The medical treatment of appendicitis may be summed up in one word, *rest*—absolute rest for the body in general and for the alimentary tract in particular. The patient should be put to bed and kept quiet in the dorsal position. No food should be given, but thirst should be satisfied by sips of hot water or small pieces of ice. Pain may be relieved by applying an ice-bag to the abdomen. The bowels may be kept at rest by the use of opium or morphin, which should be given only in small doses, so as not to dull the senses of the patient and so obscure the progress of the disease. A half grain of opium or an eighth grain of morphin is usually sufficient to quiet the violent pain. Laxatives by mouth or enemata are to be avoided.

Indications for Operation.—Operations on the appendix may be divided, according to the time at which they are performed, into two main groups: those performed during the attack, and interval operations (*à chaud* and *à froid*). The former group may be subdivided into early, intermediate, and late.

Early Operations.—An ideal operation is performed within the first few hours of the onset of the attack, before the periappendical structures have become involved and before any signs of a general toxemia have manifested themselves. Unless definite contraindications exist, operation should be undertaken at the very outset, without waiting for the development of symptoms showing whether the attack is going to be a mild or a severe one. Early operation is especially urgent in children, as they are more subject to the severe forms of appendicitis than are adults. It is impossible to tell in a given case how rapidly the disease is progressing; in some cases slight, indefinite symptoms continue for some days before the disease culminates in a severe attack; in other cases perforation is present at the onset of clinical signs. The physician should not wait for the development of pronounced symptoms before sending for a surgeon, but should make use of the other's greater experience in diagnosing surgical affections. Coffey² states that in one-half of the cases referred to him by other physicians the diagnosis has not been made before the end of the third day with any degree of positiveness. Almost all the deaths in the hands of well-trained abdominal surgeons are the result of (1) failure of the family physician to recognize the disease early, (2) temporizing with medication or with the Ochsner treatment, (3) the inability to procure a competent surgeon early, (4) the opposition

¹ Coffey, R. C.: "The Present Status of the Treatment of Appendicitis," N. Y. Med. Jour., 1906, lxxxiv, 325.

² Coffey: Loc. cit.

of members of the family to surgical intervention. Early operation has the following advantages: increased safety, as serious complications are avoided; the operation is more easily performed, as recent adhesions and periappendical exudate are not found; the patient is spared a severe illness; the use of drainage is avoided, and consequently the risk of later hernia; one operation cures the patient, whereas after late operations it is frequently necessary to perform a second operation for either hernia or for intestinal adhesions.

Intermediate Operation.—When the patient is not seen until the disease is well advanced, one of the most difficult problems that occurs in surgical practice is encountered. At this time the risk of breaking up adhesions and of distributing a partially localized, active infection is such that many surgeons prefer to wait until a later period, in the hope that the disease will abate or that a suppurative process will be well walled off and can be opened with safety. They believe that the risk of perforation is less than the risk of operating at this period. Obstipation and great distention of the abdomen with gas are conditions especially unfavorable for operation. Others believe that in competent hands the danger of spreading the septic material need not be feared, and that operation should be performed whenever the diagnosis is established. Definite contraindications to delay are, if the disease is getting worse, or if it is not definitely improving. The only case in which delay is permissible is when the patient who is seen for the first time by the surgeon is manifestly recovering from a mild attack.

A late operation is performed after the development of a well-defined abscess, for progressive peritonitis, or for other serious complications which occur late in the attack. It is never the operation of choice, but is one of necessity in some cases where, through the fault of the patient, the physician, or the surgeon, or because of some unavoidable circumstance, an early operation could not be performed. If the patient is apparently *in extremis* when first seen, there is sometimes a question regarding the duty of the surgeon, but the occasional recovery of apparently hopeless cases plainly indicates the course to be pursued.

Interval Operations.—An interval operation is one which is undertaken after the complete subsidence of an attack, whether the first or after repeated attacks, and while the patient is enjoying perfect health, for the purpose of obviating any possibility of recurrent attacks. The chief indications for an interval operation are: the recurrence of attacks at short intervals; a single attack in children, or in women who may become pregnant; chronic pain or digestive disturbances due to adhesions; and the fact that a patient who has had an attack of appendicitis is remote from surgical aid.

Preparation for Operation.—When an early operation is determined upon in a case of acute appendicitis, the preparation should be made as quickly as possible, and no consideration of convenience or sentiment should be permitted to interfere with its immediate performance. Even a few hours may be of vital moment at this time. In the course of the preparation the patient should be disturbed as little as possible. All food should be withheld and no attempt should be made to have

the bowels moved, as even a small enema may excite continuous peristalsis. A hypodermic of morphin, $\frac{1}{4}$ or $\frac{1}{2}$ of a grain, while the preparations are being made, is of value in relieving the suffering and quieting the nervousness of the patient.

Preparation of the Abdomen.—The skin of the right half of the abdomen should be shaved and the entire abdomen then cleansed by scrubbing well with hot water and green soap, applied with sterile gauze sponges. A little ether followed by alcohol should then be used, and finally the whole abdomen sterilized with 1 : 1000 solution of bichlorid of mercury. If the abdomen has been blistered, the skin should be prepared with especial care, as if there are small areas of suppuration they may result in an infection of the wound or even of the peritoneal cavity. It would be well in such a case to sponge the field of operation with potassium permanganate, followed by oxalic acid, before using the bichlorid solution, and the area about the incision may then be protected with rubber tissue. Care must be exercised not to rub the abdomen too vigorously if an abscess is suspected, as it may be ruptured.

Incision.—The best location for the incision in a given case depends upon its adaptation to the condition present. In a case of simple, uncomplicated appendicitis, an incision in the right iliac region, directly over McBurney's point, is the most convenient, but if a mass is present the incision should usually be made directly over the most prominent point, or external to it, parallel to Poupart's ligament or the iliac crest.

The principal incisions employed are: (1) The oblique, or McBurney, or gridiron; (2) the lateral, vertical, or semilunar; and (3) the median.

The *gridiron* or *McBurney incision* is the ideal one in all cases when an abscess requiring drainage is not present. If, however, an unsuspected abscess is found upon opening the abdomen, the incision can readily be extended downward by cutting directly through all the layers, and this affords an excellent opportunity for drainage. The advantages of the McBurney incision are: Its location, affording ready access to the appendix; and its freedom from danger of subsequent hernia. Since the muscle fibers are merely separated, there is practically no bleeding, and no nerves are divided.

The *semilunar incision*, performed according to Battle's method, is especially useful when there is a suspicion of an involvement of other abdominal or the pelvic organs, as it affords an excellent opportunity to inspect these structures, and, if necessary, to operate upon them. Many surgeons prefer this incision for all cases.

A *median incision* is never employed for an uncomplicated appendicitis, but may be utilized with advantage for the inspection of the appendix, and its removal, where disease of the appendix complicates the pelvic affection for which the operation is primarily performed. Its disadvantages are that the incision has to be a long one, as it is impossible to reach the base of the appendix through a short median incision. If the appendix occupies the ascending retrocecal position and is adherent, the difficulties of its removal through a median incision are so great, except in the case of great relaxation of the abdominal walls and the very long incision following the removal of a large tumor, that we consider it advisable to make a second small inci-

sion in the right iliac region rather than to unduly prolong the original incision in order to be able to retract it far enough over to the right side to reach the appendix with ease. (For a further consideration of the incision see Vol. I, Chapter XII.)

Removal of the Appendix.—After opening the abdomen the appendical region should be explored with the greatest care as so to avoid opening into a purulent focus, or rupturing a tensely distended or necrotic appendix. The intestinal or omental adhesions may be encountered immediately, and should be carefully separated as far as possible. The tip of the appendix may be visible at once, but if it does not come into view, one or two fingers may be introduced and the cecal region gently explored. The search may be facilitated by first locating the cecum and then following down the anterior longitudinal band to the base of the appendix, when it may be easily traced in whatever direction it may lie. The appendix may be completely concealed behind the cecum, and must then be sought for by loosening up the cecum until the organ is brought into view, either lying free in a peritoneal pocket or plastered to the posterior surface of the cecum or the abdominal wall.

If the appendix appears to be fairly normal, a thorough exploration should be made before removing it for the purpose of finding out the cause of the clinical symptoms. The important conditions to keep in mind are: kidney and ureteral disease, affections of the biliary apparatus, omental and intestinal adhesions, new-growth or tuberculosis of the cecum, diverticulitis, and pelvic disease.

Whenever the abdomen is opened for appendicitis the appendix should be removed, whether it appears to be diseased or not.

Typical Operation for Removal of the Appendix.—The two important steps in removal of the appendix are the ligating of its mesentery and the treatment of the stump.

Ligation of the Mesentery.—With a well-developed mesentery the vessels can usually be controlled by means of a single ligature applied to the main vessel at the free border of the mesentery near the base of the appendix. As in about 62 per cent. of the cases the head of the cecum is supplied by a branch from this vessel, it is safer not to tie it too far out, so as to include the cecal branch. On the other hand, in a small number of cases, about 5 per cent., the cecal artery supplies the proximal portion of the appendix, and precautions must be taken against hemorrhage from this source, an accident which, however, is probably avoided by the method of crushing and cauterizing the stump so generally used at present. If the mesentery is short, it is difficult to expose the main vessels above, and it is then necessary to tie the vessels singly. After tying the vessels they may be clamped on the appendical side of the ligature and the mesentery divided between. The appendix should then be isolated by means of gauze strips carefully placed about its base to prevent any possibility of contamination when it is resected.

Treatment of the Stump.—The present methods of dealing with the stump include the early crude simple ligation and excision, turning back a peritoneal cuff to cover the ligated stump after sterilization, inversion and suturing, and amputation close to the cecum and suturing. The following method is the most satis-

factory: After ligating and dividing the mesappendix a circular suture of fine silk or Pagenstecher (other surgeons prefer chromicized catgut) is placed in the cecum near the base of the appendix. It is advisable to pass the suture under the mesentery, as when it is tied it controls any bleeding at this point. The suture shown in Fig. 753 is even more satisfactory than the simple circular suture. Three clamps are then applied, as shown in Fig. 753, at the base of the appendix; the one at the



FIG. 753. HALSTED'S THREE CLAMP METHOD OF REMOVAL. FIRST STEP.
The circular suture is placed as shown; the clamps are then applied, the lower one first.

base being first applied, followed by the middle, and the distal one last. In place of the ordinary hemostatic clamp, a heavy crushing clamp, such as the one devised by Kelly or that of Ferguson, may be used with advantage. The middle clamp is then removed, and the appendix is amputated at this point with the Paquelin cautery. If the cautery is not convenient, a knife may be used and the stump may be cauterized with carbolic acid. When the clamp at the base is removed, the ribbon-like band which completely seals the stump is seized with delicate forceps

by an assistant, and carefully invaginated into the cecum; the circular suture is then drawn taut and tied. A row of mattress sutures or a continuous Lembert suture, bringing the serous surfaces together, may then be placed over this for greater security.

Adhesions.—In the case of adhesions complicating appendicitis, particular care must be taken to avoid injury to the bowel. In the simplest cases the delicate web-like adhesions are readily separated with the finger, and, as a rule, ligatures are not necessary. If dense adhesions are present, they should be carefully divided, under the guidance of the eye, with scissors, and the bleeding points tied with catgut ligatures. It is not uncommon to find a tag of omentum firmly attached to the appendix, or even to find the entire appendix rolled up in a mass of omentum. This complication is easily dealt with by removing the adherent portion of omentum with the appendix, first tying off the proximal portion of the omentum with fine catgut, and dividing it with scissors.

Removal of a Retroperitoneal or a Densely Adherent Appendix.—In certain instances where the removal of the appendix is unusually difficult the operation may be facilitated by first freeing the appendix from the cecum in the usual manner, then making a longitudinal incision over the appendix down to the submucosa or internal muscular coat, and finally stripping the appendix out of its bed by grasping the proximal end and using gentle traction. (See Fig. 759.)

Treatment of Appendical Abscess.—The important question in dealing with

a periappendical abscess relates to the treatment of the appendix. In most cases the best plan is to make a simple incision, evacuate the abscess, and freely drain it, paying no attention to the appendix. In some cases the necrotic appendix will float out with the discharge; in many cases it becomes completely obliterated and gives no further trouble; in other cases a secondary operation is required for its removal. This is easily and safely performed after the patient has been restored to health, and the infective process has subsided, leaving merely more or less dense fibrous adhesions. Israel¹ estimates that recurrent attacks take place in about 50 per cent. of the cases of simple appendicitis, but in only 5 per cent. of the sup-

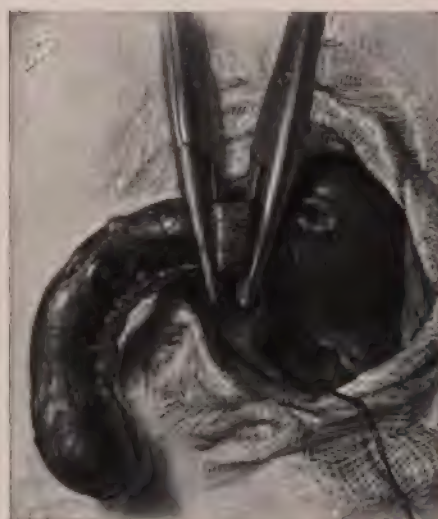


FIG. 754.—HALSTED'S THREE CLAMP METHOD.
SECOND STEP.

The middle clamp is removed, the appendix burned through with the cautery between the remaining clamps, and the stump inverted. If a knife is used in place of the cautery, care should be taken to sterilize the stump with carbolic acid.

¹ Israel, J.: "Diskussion über Appendicitis," Verhandl. ärztlich. Gesellschaft. Berl. klin. Woch., 1906, xliii, 1081.

purative cases and, if the patient is free from recurrence for two years after the attack, the appendix is probably obliterated and no further danger need be feared. The secondary operation for the removal of the appendix should be performed if there is chronic pain, if repeated attacks occur, in the case of children and in the case of pregnant women or women who expect to become pregnant. If the patient is nervous about the possibility of relapse, or if he is remote from surgical aid, operation is advisable. Jaffe,¹ out of one hundred cases which were opened and



FIG. 755.—H. A. KELLY'S METHOD.

The mesoappendix is ligated and divided. A circular suture or mattress sutures are then placed ready to turn in the stump. The appendix is then crushed near its base with powerful grooved forceps and held away from the cecum by wet gauze. It is then slowly amputated with the cautery.

drained, saw only five in which it was necessary to remove the appendix at a later date; while Barling,² in forty-nine abscess cases in which the appendix was not removed, saw only one recurrence. The incision should be made over the location of the pus and rather to the outside, near Poupart's ligament, or the crest of the ileum, and should be in the direction of the fibers of the external oblique. It is a good plan to pull the muscles open, and to open the abscess by blunt dissection. It is very essential to have an opening large enough to allow for drainage,

¹ Jaffe: "Wann soll bei Perityphlitis operirt werden," *Berl. klin. Woch.* xl, 1903, 1184.

² Barling, Gilbert: "Pelvic Appendicitis with Parappendical Abscess and Cystitis," *Lancet*, London, 1907, i, 1345.

and, if necessary, the incision may be enlarged by cutting through the whole thickness of the abdominal walls in either an upward or a downward direction, as seems best. If the appendix comes into view, it may be clamped and removed in the usual way, but, as a rule, it is better to leave it; or it may be simply tied off and the stump disinfected.

The Cleansing of the Abscess Cavity.—A wide opening for drainage and thorough evacuation are usually all that is necessary, and further manipulation is apt to do more harm than good. The cavity should, however, be carefully explored to ascertain that there are no other cavities communicating with it, or even distinct from it. If any such are found, they must be opened and drained. A cigarette drain may be placed so as to reach the lowest part of the abscess, and the remainder of it should be lightly filled with iodoform gauze.

Special Forms of Abscess.—In some cases the abscess is inaccessible without opening the general peritoneal cavity. A small periappendical abscess may be located in the midst of the rolled-up omentum, or may surround the base of the appendix, or, again, even a large abscess may form between the folds of the mesentery. The best way to approach the abscess in such cases is by means



FIG. 756.—THE STUMP IS INVAGINATED INTO THE CECUM.

of the semilunar incision, carefully isolating the purulent focus, protecting the surrounding healthy peritoneum with sterile gauze, and then evacuating the abscess transperitoneally.

In about one-third of the cases of suppurative periappendicitis the pus gravitates into the pelvis; in about one-half of this third the pus is confined to the pelvis, and may be entirely concealed in the true pelvis. In others the pelvic abscess is associated with an iliac abscess, which may have a direct avenue of communication with the pelvic abscess or may be distinct from it. In the majority of such cases the appendix itself is located in the pelvis (periappendical abscess), but in a considerable number the appendix is situated above the pelvic brim and has no apparent communication with the abscess.

In all cases of large abscess filling the pelvis, the rectal incision for evacuation

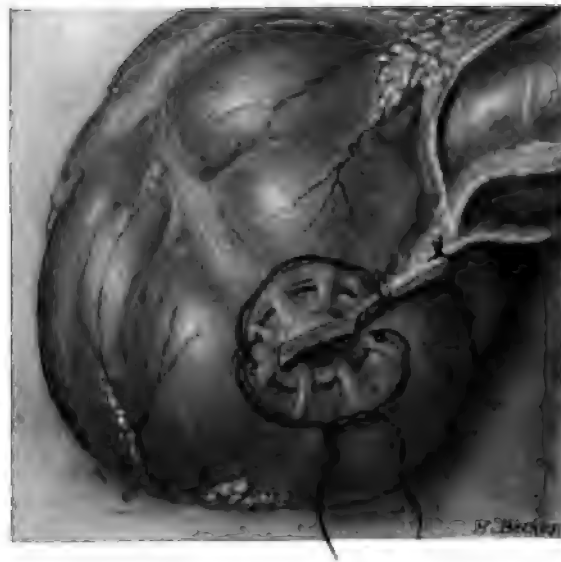


FIG. 757.—RUNYON'S SUTURE.

The suture is introduced at point *a*, carried around to point *b*, then started again at *c* and carried to *d*; the two ends at *a* and *d* are then tied.

and drainage can be satisfactorily employed, especially in men and in children. In women the abscess can be drained through the vagina when the mass is discovered in the posterior cul-de-sac. The cervix uteri should be drawn forward with a tenaculum forceps, and the posterior vaginal wall retracted, when a wide transverse incision is made just behind the cervix directly into the abscess. If the abscess is discovered after the abdomen is opened, the question arises whether to open it transperitoneally or to close the incision and drain from below. The latter we believe to be the most satisfactory procedure, if the abscess occupies the true

pelvis, as it avoids the risk attending the separation of the matted intestines above, and the difficulty of securing satisfactory drainage of the deepest part of the abscess by the abdominal route. When the abscess cannot be readily reached from below, the transperitoneal route is the best, the normal intestine, the peritoneum, and the edges of the incision being carefully protected by means of gauze packs, before opening the abscess.

Treatment of Subphrenic Abscess and of Liver Abscess.—

As soon as the diagnosis is made the only course to pursue in any case is to open and drain the abscess. A large solitary liver abscess offers some slight hope of a cure, but disseminated abscesses are beyond surgical aid. The subphrenic abscess,



FIG. 758.—THE OPERATION COMPLETED.

according to Elsberg,⁵ may be best reached as follows: About two inches of the ninth and tenth ribs are resected, somewhere between the scapular and the anterior axillary lines, according as the exploring needle has located the pus more anteriorly or more posteriorly. After the ribs have been resected, the diaphragm, with the liver shining below it, will appear in the inferior portion of the wound, and the pleura in the upper part. If there is a suspicion that the pleural cavity contains pus, it should be aspirated, and, if necessary, opened and drained at once. If there is no pus in the pleura, the upper part of the wound should be protected with gauze, and the aspirating needle should then be made to perforate the diaphragm below the pleural reflection; if the needle enters the abscess it may be used as a director. A small incision of the diaphragm beside the needle, dilatation of the opening with dressing forceps, and drainage of the abscess complete the operation. The abscess may be situated so near the median line, high up under the dome of the diaphragm, that it can be reached only by the transpleural route. The pleural cavity must then be opened through the upper part of the wound. If, however, pleural adhesions have formed, it may be possible to avoid opening into its cavity.

Treatment of Appendicitis Complicated by Diffuse or Generalized Peritonitis.

—In every case of spreading or generalized peritonitis the rule should be to operate as soon as the diagnosis is made. Many cases of acute septic or streptococcic peritonitis terminate fatally within the first twelve or eighteen hours after the appearance of the earliest symptoms, and unless operation is performed early, the disease is practically always fatal. Diffuse or generalized peritonitis does not always, however, indicate a virulent infection, and when the organism is not overwhelmed by the onslaught of highly virulent micro-organisms or the excessive amount of less severely pathogenic organisms, an immediate protective reaction takes place, and an abundant purulent or fibrino-purulent exudate is poured out which diminishes and dilutes the bacterial toxins and destroys the bacteria. Such cases are relatively favorable and recovery frequently follows operative intervention. According to Wathen,²



FIG. 759.—SHOWING THE METHOD OF STRIPPING OUT THE MUCOSA AND SUBMUCOSA IN THE CASE OF A DENSELY ADHERENT APPENDIX.

¹ Elsberg: Loc. cit.

² Wathen: "Acute Suppurative Peritonitis," Jour. Amer. Med. Assoc., Chicago, 1907, xlviii, 1919.

it is not advisable to administer opium either before or after operation for peritonitis on account of the tendency of this drug to diminish leukocytosis. On the other hand, the administration of normal salt solution per rectum after the method of Murphy, or of hot horse serum, or saline solution in the peritoneal cavity or subcutaneously, is advocated in order to stimulate leukocytosis. The operation should be performed rapidly; if possible, the focus of infection should be removed by exsecting the appendix, avoiding exposure or handling of the intestine as far as possible. Isolated foci of infection should be opened, but no attempt should be made to sponge off the intestines nor to separate adhesions. Some surgeons are strongly in favor of flushing out the peritoneal cavity with large quantities of saline solution, or of irrigating the lower abdomen and pelvis; the majority, however, agree with Wathen that irrigations are not necessary and may be harmful. Drainage should be established from the bottom of the pelvis. A cigarette drain, with loose packing of the incision with gauze, is the most satisfactory. Colotomy is rarely necessary, but is sometimes indicated in cases where there is great distention, due either to mechanical obstruction or paresis; it should then be performed rapidly and in the simplest manner. In such cases the emptying of the intestine of gas according to the method suggested by Moynihan,¹ and the use of the Mixer or Paul tube to provide drainage of the intestine itself, are at times of value.

The lateral incision may be used in most cases and gives the best opportunity to find and remove the appendix; a second suprapubic incision being made, if necessary, and drainage established through both. In women, pelvic drainage through the vagina is sometimes used in addition. In desperate cases a long median incision should be quickly made, the pus allowed to pour out, and the lowest points of infection drained. A small amount of saline solution may be poured into the peritoneal cavity or 30 c.c. of hot horse serum, as advised by Wathen, and the patient placed in Fowler's position. Saline solution may be given subcutaneously when the patient is returned to bed; and the practically continuous enteroclysis as advised by Murphy may be employed. Gastric lavage while the patient is still on the operating table is often beneficial. Such patients should be very freely stimulated by the hypodermic administration of strychnin, camphor, digitalis, caffein, and spartein, and the administration of whisky per rectum, until reaction occurs.

Treatment of Fistula.—If the fistulous tract persisting after drainage of an appendical abscess is well defined and contracted, the ideal method of treatment is the excision of the entire area with the appendix. In some instances the safer procedure is to make a free incision and curet the area, establishing thorough drainage.

Appendicostomy.—This operation was first described in 1902 by Weir,² who made use of it for the purpose of treating an intractable ulcerative colitis. Since that time it has been performed frequently, its chief indications being: the relief

¹ Moynihan, B. G. A.: "Abdominal Surgery."

² Weir, R.: "A New Use for the Useless Appendix," etc., Med. Record, 1902, lxii, 201.

of intestinal distention in cases of acute obstruction, the treatment of obstinate diseases of the colon, and artificial feeding. The operative technic is as follows: The appendix is brought out of the abdomen through a small McBurney incision and attached by its base to the abdominal walls. Care must be taken to see that the lumen is patent. After adhesions have formed, in about twenty-four hours, the appendix is amputated. The fistula may be closed later by destroying the mucosa with the Paquelin cautery, or it may be resected in the usual way.

Post-operative Complications.—For the consideration of the complications and sequelæ following operations on the appendix, see Chapter XXVI.

APPENDICITIS IN RELATION TO GYNECOLOGIC DISEASES.

The importance of the relationship between appendicitis and pelvic affections in women cannot be too strongly emphasized. Diseases of the pelvic organs are sometimes the chief factor in exciting an appendical attack, and, what is of the greatest importance, appendicitis is directly responsible for many cases of dysmenorrhea, sterility, pelvic adhesions, pyosalpinx, and ovarian abscess. The confusion of diagnosis between the two affections is of great importance, for patients suffering from chronic appendicitis are often subjected to prolonged treatment for supposed pelvic disease; while, on the other hand, cases of acute salpingitis are operated on for appendicitis. We would especially emphasize the fact that dysmenorrhea may be wholly due to chronic appendicitis, and that in cases of supposed pelvic inflammation in young girls the appendix should always be suspected.

The relationship between appendicitis and pelvic affections may be directly causal or purely accidental, and the obvious classification of diseases of the appendix from this standpoint is as follows:

1. Cases in which the appendical disease is primary and the pelvic affection secondary or consequent on the lesion of the appendix.
2. Cases in which the gynecologic affection is primary and the disease of the appendix secondary.
3. Cases in which coexisting affections of the pelvic organs and appendix are independent of each other.

In cases in which the association is accidental, the affection of the appendix, as a rule, is an old one, consisting chiefly of the presence of adhesions, kinking, thickening and induration or atrophy of the walls, stenosis, or obliteration. On the other hand, during the course of an operation for acute appendicitis, unsuspected disease of the uterus, tubes, or ovaries may be discovered.

Pelvic inflammatory disease, the result of direct propagation from a right iliac abscess, is a common event, and is more frequent in women than in men. The significance of the accident in the former is that the uterus and its adnexa, particularly the right tube and ovary, may be implicated in the suppurative process, with a resulting permanent impairment of their function. Pus tubes and ovarian abscesses are not infrequent sequelæ of suppurative appendicitis, and in less severe cases, the pelvic organs remain bound up in adhesions which are a source of persistent pain.

severe dysmenorrhea, and sterility. The pelvic disease is often limited to the right side, but the left side may also be implicated.

Appendicitis Secondary to Pelvic Inflammation.—In women the appendix frequently hangs down over the brim of the pelvis and is in contact with the right ovary, tube, or broad ligament; it is, therefore, readily involved in inflammatory affections of these organs. When situated in the iliac fossa, it may also become adherent to the enlarged tube or ovary. As a rule, in these cases, the appendix is merely adherent by its tip, and may present no gross pathologic lesions, but careful examination of such appendices shows that comparatively few are perfectly normal. A mild chronic inflammation is most often met with, but strictures, obliteration, and cystic changes are not uncommon.

Tuberculosis of the pelvic organs may be transmitted directly to the appendix through contiguity of structure, or the appendix may simply become adherent to the tubercular mass without being invaded by the disease.

The appendix is frequently adherent to tumors of the ovaries and uterus. Dermoids, and cysts with twisted pedicles, most frequently give rise to intestinal adhesions involving the appendix. An acute appendicitis developing under such conditions may infect the cyst and cause suppuration of its contents.

Differential Diagnosis.—The clinical history of some pelvic affections so exactly simulates appendicitis that a differential diagnosis is extremely difficult. In many cases the differential diagnosis is of importance chiefly from its bearing upon the technic of the operation, as in any case surgical intervention may be imperative, but at other times palliative treatment may be indicated if the case is one of pelvic disease; whereas, if it is an appendical attack, delay may cost the patient's life. The questions which arise are: Is the case one of appendicitis? is it a case of pelvic disease? or do lesions of both organs exist?

Inflammatory diseases of the right adnexa are most frequently confounded with appendicitis. The chief reliance is to be placed on the history of the onset of the attack. Acute pelvic inflammation is usually preceded by a vaginal discharge and sometimes dysmenorrhea; whereas in appendicitis a history of digestive disturbances or of previous attacks of pain in the right side is often given. In appendicitis the initial pain is apt to be colicky and general; while in pelvic disease it is more steady and less intense. The local pain and tenderness are situated more deeply in the pelvis and inguinal region and the most exquisite tenderness is elicited by pressure over Poupert's ligament. With a supervening peritonitis the differential diagnosis is practically impossible.

Ruptured extrauterine pregnancy and *ovarian tumor with a twisted pedicle* are frequently mistaken for acute appendicitis. The sudden acute onset, often accompanied with nausea and vomiting, is strikingly suggestive of appendicitis. The pain, however, is seldom colicky. An accurate account of the events leading up to the attack, together with a careful bimanual examination, will usually make the diagnosis perfectly clear; sudden agonizing pain at the onset, immediately followed by fainting, and definite evidence of internal hemorrhage, are practically pathognomonic

of ectopic pregnancy. The acute initial pain of appendicitis may be followed by syncope, but other evidence of hemorrhage is lacking.

Ovarian cyst with twisted pedicle is usually easily recognized by means of a bimanual examination, if necessary, under an anesthetic. In all the cases the most important factor in making a differential diagnosis between appendicitis and pelvic disease is the recognition of the fact that confusion may exist.

The diagnosis of coexisting affections is often extremely difficult, as the symptoms arising from the one affection may completely mask the other. When the patient is known to be suffering from some pelvic inflammation, the development of an appendical attack may unfortunately be attributed to an exacerbation of the pelvic disease. The greater severity of the abdominal and constitutional symptoms in appendicitis, however, should suggest the complication. In doubtful cases an exploratory section entails less risk than delaying the operation until the diagnosis is clear. In all cases of pelvic disease where there is a possibility of error, the abdominal route is preferable to the vaginal. Acute appendicitis, occurring in a patient who is known to be the subject of an ovarian cyst, naturally suggests torsion of the ovarian pedicle; fortunately, early abdominal section is indicated in either case. The surgeon must be on his guard, when a tumor or other pelvic affection is discovered during the course of an examination in a case of appendicitis, not to mistake it for the sole cause of the symptoms; and, on the other hand, a careful pelvic examination should be made in every case of appendicitis.

TREATMENT.

An examination of the appendix whenever the abdomen is opened is now the routine procedure of practically all gynecologists, except in a few cases of simple retroflexion, where the very small incision may not afford an opportunity to find the appendix unless it occupies the pelvic position. If there is the slightest suspicion of appendical trouble, the incision should be prolonged in any case, so as to bring the appendix into view.

The removal of the normal appendix when the abdomen is opened for some other cause is not justifiable except in certain cases where there is a possibility of operation performed in the neighborhood giving rise to post-operative adhesions in which the appendix may become involved. In all pelvic operations the intraperitoneal appendix, pointing downward, may become adherent to the operative area. Fig. 760 illustrates a case where the appendix became adherent in a case of simple suspension of the uterus.

Incision for Removal of the Appendix.—In the majority of cases the operation is performed primarily for the relief of the pelvic trouble, and the median incision is the best for this purpose. If the abdominal walls are lax or if the incision is 8 or 10 cm. long, the opening is easily drawn over to the right side and the iliac fossa may be easily explored. The appendix is difficult to reach through a median incision of only 4 or 6 cm., and in such a case the choice lies between lengthening the incision

or making a second incision over the appendix. As a rule, we prefer the second incision in such cases, since, if the appendix should happen to occupy the retrocecal position, or if the cecum has a short mesentery, a lateral incision is usually necessary.

The semilunar incision is the best where coincident appendicitis and right-sided pelvic disease is suspected, or where the diagnosis is doubtful between right-sided pelvic disease and appendicitis.

Lateral Incision.—When the appendix is not easily reached through the median incision, it is advisable to make an incision directly over the appendix; or when on



FIG. 760. — LONG APPENDIX ADHERENT BY ITS TIP TO THE SUSPENSORY LIGAMENT ATTACHING THE UTERUS TO THE ABDOMINAL WALL.

Case of myomectomy and suspension of the uterus; subsequent operation for appendical complications.

exploring the right iliac region through the median incision a periappendical abscess is discovered, it is best to open it extraperitoneally by means of an incision outside of the mass, using the median incision as a guide. The median incision is then closed, care being taken to keep it free from contamination throughout the course of the operation.

Removal of the Appendix.—The general rule to be observed in connection with the removal of the appendix during the course of a pelvic operation is that the clean operation should be done first. If there is no suppuration, either operation may be



FIG. 761.—EXTENSIVE INVOLVEMENT OF THE APPENDIX IN TUBO-OVARIAN ABSCESS. WIDESPREAD ADHESIONS TO UTERUS AND PELVIC WALLS.

A. The mesoappendix is tied off and the appendix detached at its base and grasped as shown in the lower figure, then the ovarian vessels are exposed and tied at B. Lastly, as the appendix, tube, and ovary are lifted out of their bed of adhesions the tube is excised from the cornu at C.

done first; but it is generally advisable to give precedence to the pelvic operation. If both are infected, it is best to remove the appendix at once, as this must be done.

In the case of pelvic adhesions involving the appendix, one of three procedures may be adopted. If the adhesions are light, they may be separated and the two conditions treated independently, but if the appendix is densely adherent to the tube or ovary, it is better not to try to separate them, but to remove the pelvic organ and appendix *en masse*, beginning either by clamping and dividing the cecal end of the appendix and closing the opening in the cecum, or by detaching the tubo-ovarian mass and with it the appendix, which is finally clamped and separated at its base.

When the appendix coalesces with the tube and ovary to form a pelvic abscess, extreme care must be taken not to distribute the infection over the peritoneal cavity. In the case of a large abscess, if the patient is in bad condition, it may be advisable simply to make a vaginal incision and evacuate and drain the cavity, leaving the appendix to be removed later. A small abscess may be enucleated by first detaching the appendix from the cecum, then tying the ovarian vessels and the uterine end of the tube, and finally carefully peeling out the mass.

When the appendix is adherent to a uterine or ovarian tumor, it may be detached from the growth, if the adhesions are light, and removed after the tumor; or, if the adhesions are dense, it is best, when possible, to free the appendix first at the cecal end and remove it with the mass.

Appendicitis Complicating Pregnancy, Labor, and the Puerperium.—The question of the relation of appendicitis to pregnancy, labor, and the puerperium demands especial consideration on account of the diagnostic difficulties and the extreme gravity of the complications menacing the life of both mother and child which may arise. It is only within the last decade that the importance of appendicitis in women during the child-bearing age has been recognized. Abrahams,¹ in 1897, was able to collect only fifteen cases from the literature, but since that time many cases have been recorded, and it is now pretty generally known that abdominal pain and tenderness developing during pregnancy may be due to appendicitis, that abortions may be caused, and that puerperal fever may result from it. It is not necessary to assume a direct etiologic relationship to account for the occurrence of appendicitis during pregnancy, and probably in the majority of cases the connection is accidental. The normal appendix is subject to practically the same conditions during pregnancy as at other times; as Fränkel² claims, an organ so variable in size, form, and position, and normally so easily movable, can be easily adapted to the varying conditions of pressure in the abdomen. But when the appendix has been prepared by antecedent disease, or when adhesions and kinking are found, the alteration in its anatomic relations involves more or less danger of exciting an acute attack. The forcible contraction of the uterus and its sudden change in position after delivery are extremely dangerous when the appendix is adherent to

¹ Abrahams, R.: "Appendicitis Complicating Pregnancy," *Am. Jour. Obst.*, 1897, xxxv, 205.

² Fränkel, E.: "Die Appendicitis in ihren Beziehungen zur Geburtshülfe und Gynäkologie," *Sammlung. klin. Vort.*, 1898, No. 229, 1335.

the uterus or adnexa, and especially when the uterine wall forms part of the wall of an appendical abscess.

The Effect of Appendicitis upon Pregnancy.—In mild attacks the normal course of the pregnancy is not disturbed, but in severe attacks, unless cut short by early operative interference, the prognosis is extremely grave. Operations have been performed for suppurative periappendicitis and for gangrenous appendicitis with general peritonitis, and the pregnancy has then gone on to term and a healthy child has been born. Usually, however, in severe cases abortion ensues. In some cases the fetus dies *in utero* from toxemia or septicemia, and is then expelled; but more frequently the uterine contractions are primarily excited and a living child is expelled. If premature delivery occurs early in the attack, a healthy child may be born; but if the patient has become profoundly septic, or if infection of the uterus has occurred before delivery takes place, the infant soon succumbs. With the act of parturition there is the double danger of the almost inevitable rupture of adhesions, with the distribution of the infection, and the danger of direct infection of the uterus. It is not the miscarriage itself which produces the fatal result, although it is frequently followed by a rapidly fatal termination, but the general and local infection which induces the abortion also causes the death of the mother.

The *diagnosis* is often difficult. A typical case is easily recognized, but if the pain and tenderness are not definitely localized, and if constitutional disturbances are slight, the symptoms are often mistaken for threatened abortion; and if the attack occurs during labor, the appendical symptoms may be attributed to the labor. Appendicitis developing after delivery may simulate puerperal infection, and indeed may be accompanied by an infection of the uterus. The differential diagnosis between appendicitis during the early months of pregnancy and a ruptured extra-uterine pregnancy may be very difficult. The chief reliance in all cases must be placed upon the localization of the pain and tenderness in the appendical region. During pregnancy the presence of marked constitutional symptoms, fever, and accelerated pulse, also speaks for appendicitis.

Treatment.—The most important point in the treatment of appendicitis complicating pregnancy is its prophylaxis. Every woman who has suffered from an attack of appendicitis, however mild, should have the appendix removed, if she is liable to become pregnant. Every pregnant woman, especially if she gives a history of antecedent appendical disease, should be kept under careful observation, and if any symptoms of an appendical attack arise, operative interference should be promptly undertaken as soon as the diagnosis is reasonably certain. The risk to both mother and child in severe cases of appendicitis during pregnancy has been estimated as high as 50 per cent.; whereas with early operation and removal of the appendix before suppuration or gangrene have supervened, the risk to the mother is almost *nil* and the pregnancy proceeds normally in practically all cases. When abortion follows the operation, it is due to some complication necessitating the manipulation of the uterus, or is the result of the disease. If the McBurney incision is closed without drainage, there is no weakness of the abdominal walls

to be feared. A localized abscess should be treated by incision and drainage, as little manipulation as possible being employed. The pregnancy may advance to term, but abortion is liable to occur, and the danger of infection of the uterus and of imperfect contraction and post-partum hemorrhage then are added.

Toward the end of pregnancy the question is more perplexing. An unnecessary operative interference at this time is not so harmless a procedure as in early pregnancy. Operation at this time is more apt to induce labor, and it is somewhat more difficult to perform if the appendix is not easily accessible; the recent McBurney incision may give way, and labor may be prolonged, as the force of the abdominal muscles is impaired. If the patient is suffering from a definite appendical attack, however, a timely operation involves far less risk than allowing the disease to progress. Moreover, even if the attack should subside, adhesions may have formed which later, with the advent of labor, may give rise to further trouble.

Appendicitis developing during the first few days of the puerperium closely simulates puerperal infection. The localization of the pain and tenderness associated with nausea and vomiting usually lead to a correct diagnosis, especially when there is a history of previous appendical attacks. Prompt surgical interference should be made as soon as the diagnosis is reasonably certain.

SPECIFIC INFLAMMATORY DISEASES OF THE APPENDIX.

Specific inflammatory diseases of the appendix include typhoid fever, tuberculosis, actinomycosis, and amebic dysentery.

Appendicitis in Typhoid Fever.—Appendicitis may be related to typhoid fever in the following ways:

1. The appendicitis may be an accidental accompaniment of typhoid fever, or a latent or chronic appendicitis may be roused into activity by typhoid fever.
2. A true typhoid infection of the appendix may produce symptoms resembling a simple acute inflammation, and naturally may go on to perforation. The typhoid infection of the appendix may be accompanied by a secondary infection with the ordinary pyogenic micro-organisms.
3. Appendicitis may develop so soon after the subsidence of typhoid fever that a causal relationship is suggested; or latent germs harbored in the appendix may cause an appendical attack at a more or less remote period.

It is generally stated that the appendix is involved in about one-third of all cases of typhoid fever, and that perforation of the appendix forms 5 per cent. of the typhoid perforations. Typhoid lesions in the appendix vary greatly in extent and severity. In the majority there is merely a slight congestion; in others, the whole appendix is swollen and turgid and the lumen practically obliterated by the swollen mucosa and submucosa. Typical typhoid lesions with or without ulceration are found in the tissues. Where there is ulceration, a secondary invasion with pyogenic bacteria is liable to occur, and an acute suppurative appendicitis develops. The simple typhoid lesions in the appendix may go on to perforation or may undergo

the usual reparative changes. The development of a pyogenic infection during the course of typhoid fever is not different from an uncomplicated appendicitis. The development of an appendical attack after the subsidence of typhoid fever may be a mere coincidence, but it is possible that, as in the case of the gall-bladder, the typhoid germ may be harbored in the appendix longer than in the general intestinal tract, and, remaining latent for a longer or shorter period, may finally determine a subacute or an acute local inflammation.

The Symptoms and Diagnosis.—The decision for or against operation for appendicitis in a patient who has typhoid fever is of extreme gravity. At the outset of the illness, when the symptoms are not fully developed, the first question to be answered is: Has the patient appendicitis or has he typhoid fever? In some cases an immediate answer cannot be given, but when there is reason to suspect typhoid fever and any of the typical symptoms of appendicitis are lacking, the case should be kept under the closest observation, and every available means used to arrive at a decision. Typhoid fever may be marked at the outset by localized pain, tenderness, and rigidity, with fever, but, as a general thing, the tenderness elicited on pressure is not so exquisite as in acute appendicitis. Rolleston,¹ as a result of numerous observations, believes that the absence of the abdominal reflex in the presence of pyrexia excludes appendicitis and is suggestive of enteric fever. The expression of the patient and the character of the fever are valuable aids in reaching a diagnosis. The leukocyte count is of great value in making a differential diagnosis between the two affections. In typhoid fever the leukocytes are not increased and there may be a distinct leukopenia; the mononuclear cells, especially the large ones, are increased; while in appendicitis the polymorphonuclears are increased. The Widal reaction is obtained too late to be of value in these cases. Perforation of a typhoid ulcer may exactly simulate acute appendicitis. As immediate operation is indicated in either case, a differential diagnosis is of less importance.

Treatment.—Where there is a question as to the true condition, operation should be delayed until no possibility of a mistake remains, unless urgent symptoms arise. When appendicitis develops in the course of a typhoid fever, it should be the rule not to operate during the first ten days, in the absence of urgent symptoms, and not

¹ Rolleston: "The Abdominal Reflex in Enteric Fever," *Brain*, 1906, cxiii.



FIG. 762.—TYPHOID APPENDIX, ELEVENTH WEEK.

a, Healed ulcer; b, more recent superficial ulcers covered with exudate; c, mass of partially organized exudate.

at all during the course of the disease if the appendicitis is apparently of a mild type.

Tuberculosis of the appendix may be primary or secondary, the latter condition being due to direct extension by continuity from the cecum; or to transplantation of the infective organism from some distant organ, usually the lungs, in which case the tuberculous lesion may be disseminated throughout the entire intestinal tract or may be limited to the appendix. In most instances appendical tuberculosis is merely part of an ileocecal infection. Miliary tuberculosis of the serous surface due to infection by contiguity or continuity from the general peritoneum, the pelvic organs, or some other focus, is comparatively frequent, but possesses little practical interest, apart from the fact that tuberculous adhesive bands may cause a twist or stricture of the appendix. Primary intestinal tuberculosis limited to the appendix is apparently extremely rare, though probably not so rare as it seems to be, as in many cases the tuberculous nature of the appendical inflammation is only recognized by the microscope; and, on the other hand, it is possible that in some cases where there was a more generalized process, the appendix was the starting-point of the infection.

Primary tuberculosis of the appendix presents two distinct types: the usual ulcerative, caseous, or fibrocaseous form, and the hyperplastic form. The ordinary variety of tuberculous appendix resembles a simple subacute or chronic appendicitis. The serous surface may show a few miliary foci, and on examination of the mucosa typical ulcers are usually found. The appendix is little, if at all, larger than normal, and may even appear more or less atrophic. The lumen may be distended with caseous material.

Hyperplastic tuberculosis of the cecum is well known, but, as a rule, the appendix is not affected, and with the exception of Crowder's¹ case (Fig. 763), we have found no cases reported in which the affection apparently originated in the appendix. This variety of tuberculosis is characterized by the enormous hypertrophy of the intestinal walls, usually associated with narrowing of the lumen. The normal contour of the part is usually well preserved; cicatricial contractions, however, may produce slight irregularities in form, and masses of fat in the outer layers may cause irregular elevations on the surface. Histologically, the most conspicuous feature is the general fibrous proliferation affecting all the tissues, but most pronounced in the submucosa. Lymphoid cells are abundant, occurring in clumps and singly. Epithelioid cells and caseation may be entirely lacking, but microscopic tubercles are usually found in places. The lesion is essentially that of a chronic productive inflammation associated with a tuberculous process. Tubercle bacilli are usually scanty, but may be abundant. The disease is essentially chronic, and the hyperplastic process is explained by Crowder as a conservative effort on the part of the tissues to resist the growth and invasion of the bacilli.

Clinical History.—While the affection is limited to the appendix there are no

¹ Kelly, H. A., and E. Hurdon: "The Vermiform Appendix and Its Diseases," pages 338 and 763.

signs or symptoms by which it can be distinguished from simple appendicitis. The disease is chronic in its course, but finally there is extensive invasion of the ileocecal region, and the appendical symptoms are masked by those of a more pronounced character produced by the cecal affection.

The *treatment* of tuberculous appendicitis is precisely the same as that of simple appendicitis, especial attention, however, being directed to the condition of the adjacent portion of the cecum, and the inguinal lymph-glands. The treatment of the tuberculous appendix when it is a part of an ileocecal infection is considered elsewhere.

Actinomycosis.—The appendix is usually considered to be the chief portal of entry for the infective agent in abdominal actinomycosis. Pure actinomycotic infection in man excites merely a chronic productive inflammation, but as the micro-organism enters the tissues through a cavity beset with bacteria, a secondary infection producing suppuration is an almost constant accompaniment. In the



FIG. 763.—HYPERPLASTIC TUBERCULOSIS OF THE APPENDIX.
In the cross-section tubercles (a) appear as deeply stained nodules.

early stages the products of the infection appear as a brawny, pseudo-fluctuant, tumor mass, which, after a longer or shorter period, ceases to be localized and invades neighboring structures, forming indurated masses accompanied by an edematous condition of the surrounding tissues. The disease spreads in all directions, and finally invades the abdominal walls, usually resulting in the formation of multiple fistulae. Embolic infection by way of the blood-vessels sometimes occurs. The small irregular cavities distributed throughout the dense scar-like masses are lined with soft reddish-brown granulations, which are bathed in a scanty, puriform fluid containing the characteristic yellowish actinomycotic granules.

Etiology.—The disease is probably contracted from grain or from infected animals, and is most commonly found in farmers, cattlemen, and those concerned with the management of live stock or grain. There may be a definite history of caring for infected animals, and a grain of wheat or barley has been found in the midst of the actinomycotic mass. Men are more frequently attacked than women,

probably on account of the difference in their daily avocations. The disease is most common during middle life. It may run a rapid course, one case lasting only four weeks, but it is usually chronic and continues for years, the early lesions showing a reparative process, while new foci are developing elsewhere. The clinical symptoms at the outset resemble those of acute appendicitis, but after the acute symptoms have subsided, a tender swelling persists in the right side. As the disease advances there is a progressive increase in the size of the mass, associated with a characteristic brawny induration of the skin. Neighboring structures are involved by contiguity or continuity, and in some cases metastases occur. Finally, sinuses form in various regions. The temperature, which is only slightly elevated at first, later becomes septic in character, and there are frequent chills. The leukocytes may be almost normal or there may be a marked leukocytosis. The diagnosis is verified by finding the characteristic yellow granules in the abscess foci, and the demonstration under the microscope of the fungus.

Treatment.—Early removal of the appendix with resection of the adjacent portion of the cecum, if at all infiltrated, may cut short the attack. Usually, however, the disease is too far advanced for complete enucleation, and the chief reliance must be placed upon the widest possible excision, and thorough curetting and drainage of remaining cavities. The administration of potassium iodid in large quantities is a useful aid in controlling the disease.

Amebic Dysentery.—The appendix vermiformis is often severely affected in cases of amebic dysentery, the perforation of an amebic ulcer in the appendix sometimes causing a fatal peritonitis (Roger¹). The earliest lesions consist of small reddish elevations with yellowish centers. These soon develop into round or oval ulcers, which later lose their regular form and appear as long, irregular ulcers, filled with gelatinous material, or as thickened, raised patches with light yellow or tawny, ragged sloughs. The ulcers may undergo resolution, a patch of scar tissue remaining, or perforation may occur. The diagnosis has not been made during life, as the appendical affection is masked by the disease of the colon.

NEOPLASMS.

Primary tumors of the appendix are infrequent, and its secondary invasion by tumors originating elsewhere is extremely rare. By far the greatest number of appendical tumors described are carcinomata. A few isolated cases of benign tumors have been observed, and include three myomata, two fibromata, two myxomata, a lipoma, and a few cases of mucous polypi, probably of inflammatory origin. These tumors were of small size and were all discovered accidentally. There are five cases of sarcoma recorded, three of which were undoubtedly primary in the appendix, and two designated as endothelioma. The appendix may also be involved in cases of lymphatic tumors, where multiple foci of disease exist, as in Hodgkin's disease.

¹ Roger: Loc. cit.

Carcinoma.—There are about seventy cases of primary cancer of the appendix on record, in most of which the diagnosis was verified by the microscope. In every case the tumor was discovered only after operation or at autopsy, and in many of the operative cases the nature of the disease was not recognized until the microscopic examination was made. In five cases, or 12 per cent., secondary growths were present, but in the remaining cases the tumor was limited to the appen-



FIG. 764.—CARCINOMA OF THE APPENDIX CAUSING ACUTE PERFORATIVE APPENDICITIS.

dix. In about half, the tumor was situated at or near the tip of the appendix and appeared as a small, hard nodule, varying from the size of a pea to that of a marble. In one or two cases there was a diffuse growth without definite limitations. When the tumor was situated in the middle or proximal parts of the appendix, the canal was usually encroached upon, or even completely obstructed. Histologically, there were a few examples of cylindric-cell carcinoma, but the majority of the tumors were made up of solid clumps of small spheroidal or polymorphous cells, having sharply

stained vesicular nuclei, and often showing a conspicuous vacuolization of the cell (basal-cell carcinoma). The tumors of this variety, comprising about half the cases, all occurred in young individuals, having an average age of about twenty-four years. They are apparently benign in their course, as no case of recurrence has been observed, although, as a rule, the growth had invaded the peritoneal coat of the appendix. In the five cases of cancer in which the disease had extended beyond the appendix, we are not aware that any were of this nature. In several cases patients have been operated on again for some other affection two or three years later, and no evidence of recurrence has been noted. In the case of cylindric-cell carcinoma the ages of the patients corresponded with that at which intestinal carcinoma usually develops, and extension of the growth beyond the limits of the appendix is frequent. Colloid carcinoma also occurs in the appendix, and, like the cylindric-cell variety, develops in persons of advanced years.

The usual clinical history is that of some form of appendicitis. In several cases perforation occurred, usually at a point beyond the obstruction produced by the growth, and symptoms of peritonitis developed. In three cases, after a long history of chronic right iliac disease, a fecal fistula formed, which later was lined with malignant granulations.

Treatment.—Excision of the appendix in the majority of cases results in a permanent cure. If the growth is situated in the proximal part of the appendix, the adjacent portion of the cecum should be resected and the retrocecal glands should be carefully inspected and removed if there is any evidence of disease. If the cancer is of the cylindric-cell or colloid variety, the widest possible enucleation should be made, including a large portion of the cecum and all the retrocecal tissues.

Hernia of the Appendix.—The appendix may form part of the contents of almost any form of hernia, including both right and left inguinal, umbilical, obturator, and femoral hernias. It is most frequently found in a right inguinal hernia and may form the sole contents of the sac. It is liable to become adherent, acutely inflamed, or strangulated. In some instances the small cylindric body may be felt, but, as a rule, a diagnosis cannot be made before operation.

The only treatment is the radical cure of the hernia, accompanied by resection of the appendix, which is usually readily performed through the hernial ring. It is not advisable to return even an apparently normal appendix to the abdomen, as the proximal end is often diseased.

CHAPTER XXXVI.

SURGERY OF THE PANCREAS.

BY EUGENE L. OPIE, M.D.

Historical.—Twenty-five years ago operations upon the pancreas were unknown. In 1881 Bozeman¹ successfully extirpated a cyst of the pancreas, and the same year Kulenkampff² treated this disease by incision and drainage. Gussenbauer³ the following year operated upon a cyst of the pancreas by stitching it to the abdominal wall, emptying the contents after incision and packing with gauze. A large proportion of all pancreatic operations have been performed upon cysts by this method or upon peri-pancreatic abscesses by almost identical procedures. In 1886 Senn⁴ demonstrated by systematic experiments on the dog that incised wounds of the gland healed readily, whereas pancreatic substance injured by crushing was absorbed, provided the seat of injury remained aseptic. Brunner (1709) had successfully extirpated part of the pancreas in animals, but von Mering and Minkowski⁵ first succeeded in keeping animals alive after total extirpation of the gland until death ensued as the result of diabetes mellitus. Removal of a solid tumor of the pancreas was successfully accomplished by Trendelenburg,⁶ who extirpated the tail and body of the gland invaded by sarcoma. Acute hemorrhagic and gangrenous pancreatitis has been treated by surgical methods, while in two instances pancreatic calculi have been removed from the duct of Wirsung.

The difficulty of diagnosis of pancreatic disease and the inaccessibility of the gland, which is in intimate relation with a variety of vital structures, have greatly diminished the possibilities of purposeful surgical interference. A large proportion of operations upon the pancreas, those performed for the relief of cysts being excepted, have been completed after pancreatic disease has been discovered at operation undertaken for the purpose of exploration or as the result of a mistaken diagnosis. The recorded experience of a surgeon has usually been small; Mikulicz⁷

¹ Bozeman, N.: "Removal of a Cyst of the Pancreas Weighing Twenty and One-half Pounds," New York Med. Rec., 1882, xxi.

² Kulenkampff, D.: "Ein Fall von Pankreas-Fistel," Berliner klin. Woch., 1882, xix, 102.

³ Gussenbauer, Carl: "Zur operativen Behandlung der Pankreas-Cysten," Arch. f. klin. Chir., 1883, xxix, 355.

⁴ Senn, N.: "The Surgery of the Pancreas," Amer. Jour. of the Med. Sciences, 1886, xcii, 141, 423.

⁵ Mering, J. von, and Minkowski, O.: "Diabetes mellitus nach Pankreasextirpation," Arch. f. exper. Path. u. Phar., 1889, xxvi, 371.

⁶ Described by Witzel: Deutsche Zeit. f. Chir., 1886, xxiv, 326.

⁷ Mikulicz, Joh. von: "Surgery of the Pancreas," Trans. of the Cong. of Amer. Phys. and Surg., 1903, vi, 55.

cites the exceptional number of sixty operations performed during a period of twelve years.

Surgical Anatomy.—Attached to the posterior abdominal wall and in front of the aorta the pancreas occupies the posterior wall of the lesser peritoneal cavity. Inflammatory disease of the pancreas is almost invariably communicated to the overlying peritoneal surface, and peritonitis, limited in most instances to the lesser peritoneum, results. Accumulation of inflammatory exudate in the bursa omentalis after closure of the foramen of Winslow by adhesions not infrequently produces a



FIG. 765.—SHOWING THE ANATOMY OF THE PANCREATIC DUCTS AND POSTERIOR RELATIONS OF THE PANCREAS IN A BOY.

tumor palpable externally and other symptoms not infrequently referred to the gland itself.

The head of the pancreas, lying within the duodenal loop and in immediate contact with the blood-vessels, of which the integrity is essential to this part of the intestine, is firmly attached to the tissues overlying the vertebral column. The bile-duct in fifteen subjects (Helly¹) passed along a groove upon the surface of the gland, while in twenty-five individuals it was wholly surrounded by glandular tissue.

Since the splenic vein with the splenic artery passes along the upper margin of the

¹ Helly: "Beitrag zur Anatomie des Pankreas," Arch. f. mik. Anat., 1898, lii, 773.

gland, and supplies it with numerous branches, while the superior mesenteric vein occupies a groove upon the posterior surface of the head, inflammatory lesions of the pancreas not infrequently cause thrombosis of both these vessels and of the portal vein. Krönlein¹ has shown that the median colic artery in a small proportion of cases arises from the superior mesenteric near its origin; and in a case which he describes ligation of the artery during the removal of carcinoma of the pancreas was followed by gangrene of the colon. In most instances the artery arises at some distance from the gland and is not a source of danger.

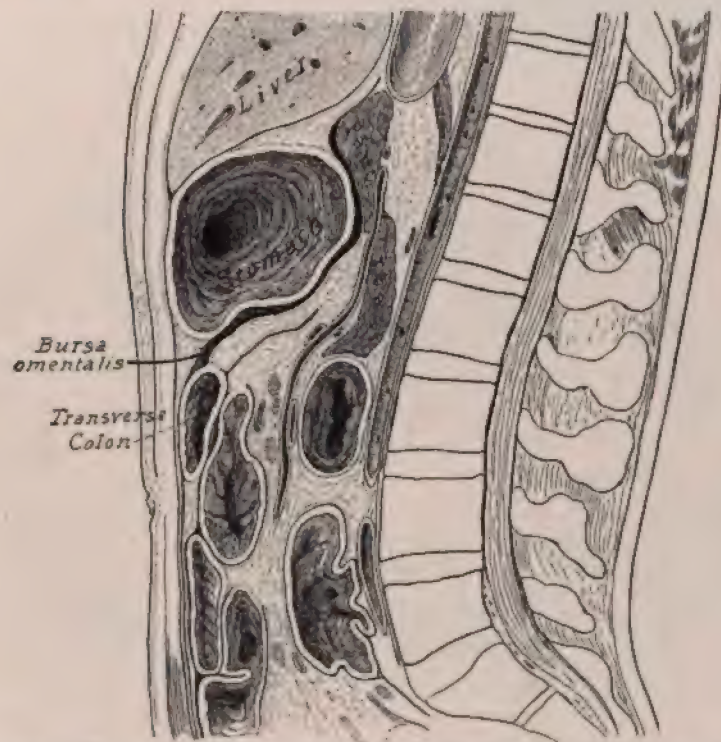


FIG. 766.—RELATION OF THE PANCREAS TO THE LESSER PERITONEAL CAVITY (after Brauer).

Since the tail of the pancreas is less intimately bound to the surrounding structures, it permits greater movement of cysts and tumors arising in this part of the organ, and, serving as a pedicle, facilitates their removal. Extirpation of cysts and solid tumors has, with few exceptions, been limited to those situated in this part of the gland. Since section and closure of the duct are followed by chronic inflammation, subsequent injury to the gland is least when the distal part of the pancreas is implicated.

The pancreas may be exposed by operation (1) through the peritoneal cavity, in which case the greater peritoneal cavity is opened and the lesser cavity entered

¹ Krönlein, R. N.: "Klinische und topographisch-anatomische Beiträge zur Chirurgie des Pankreas," *Beit. z. klin. Chir.*, 1895, xiv, 663.

(a) usually through the gastrocolic ligament between stomach and colon, the great omentum being pushed upward or penetrated; (b) when the lesion, such as a cyst, a tumor, or an abscess, is situated in the upper part of the head of the pancreas, it may, with increasing size, present above the lesser curvature of the stomach between liver and stomach, and is most accessible by incision through the gastro-hepatic omentum; (c) in some instances, particularly where cysts, usually arising from the tail of the pancreas, force their way into the transverse mesocolon, the lesion may be reached by carefully avoiding the blood-vessels through the lower layer of the mesocolon after pushing upward the omentum. The pancreas may be exposed (2) extraperitoneally through the lumbar region: (a) the tail of the gland

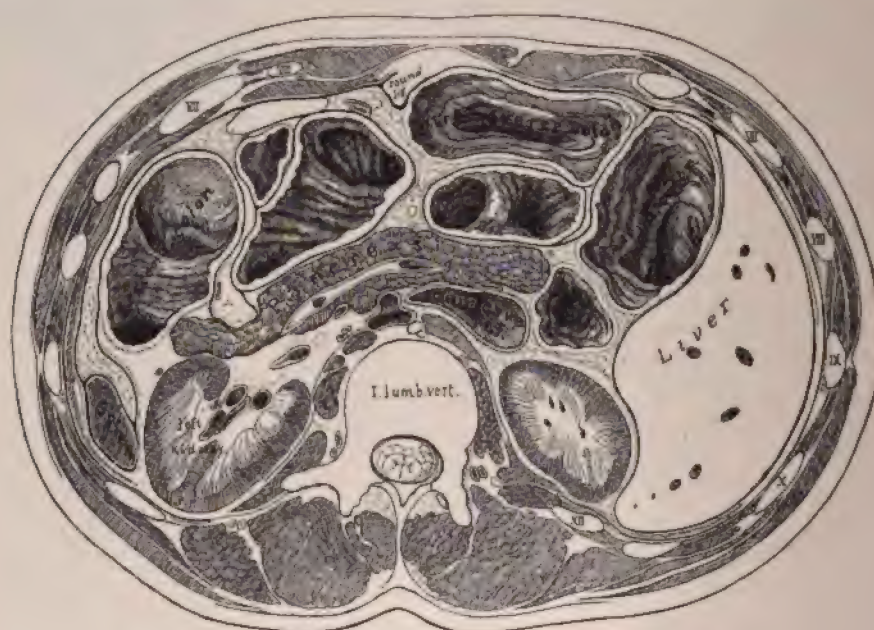


FIG. 767.—HORIZONTAL SECTION OF BODY AT THE LEVEL OF THE PANCREAS.

is accessible through the left lumbar region and drainage of peri-pancreatic abscesses, particularly those which have sunk downward by erosion of the retroperitoneal tissue, has been accomplished by the same route; (b) cysts and abscesses of the head of the pancreas pushing their way to the right have occasionally been found accessible through the right lumbar region.

General Pathology.—Since the pancreas is richly supplied with blood-vessels which are distended when the gland is secreting actively, hemorrhage after injury is controlled with difficulty. Deep sutures into the glandular parenchyma by occluding blood-vessels may cause necrosis of glandular tissue, and by occluding ducts may cause chronic inflammation of the tissue drained by those ducts which have been obstructed. An even greater danger is referable to the peculiar physi-

ology of the gland which furnishes a proteolytic enzyme so active that it is capable of eroding the skin in the neighborhood of a pancreatic fistula.

It is not improbable that partially necrotic pancreatic tissue which is undergoing auto-digestion is even more toxic than products of secretion. Ligation of a part of the pancreas in such a way as to occlude its circulation and produce necrosis, according to Doberauer,¹ causes death in dogs within seven days. There are so-called fat necroses and subserous hemorrhages and the peritoneal cavity contains hemorrhagic exudate. Pancreatic tissue of one animal, which has been subjected to the operation, introduced into the peritoneal cavity of a second animal causes the same fatal result. Necrosis of fat caused by contact of pancreatic secretion with adipose tissue further demonstrates the injurious effects of products of secretion which may escape into a wound implicating the gland. Nevertheless, products of secretion can to a certain extent be absorbed and rendered harmless; the normal blood-serum, it is well known, exhibits active antitryptic action.

The escape of pancreatic juice into the peritoneum and its irritant action, referable in considerable part to trypsin, offers conditions which favor the multiplication of bacteria introduced at the time of operation; general peritonitis may occur, particularly since a variety of pancreatic lesions are followed by invasion of bacteria from the duodenum. Mikulicz cites from his own experience ninety-one cases of resection of the stomach for gastric cancer, with no injury to the pancreas; twenty-five, or 27.5 per cent., died as a result of the operation. In thirty cases the pancreas was injured, the torn parenchyma being exposed by separating adhesions between the tumor and pancreas. The fatal result in twenty-one of these cases, 70 per cent., was not referable, according to Mikulicz, to the greater severity of the operation, because in most of the cases death was the result of peritonitis.

The necessity for drainage by tampons of gauze, when there is a possibility of the escape of pancreatic secretion into the peritoneal cavity, is demonstrated by the statistics of the same surgeon. In twenty-seven cases of acute disease of the pancreas described in the literature of the subject, the statement is made that drainage was employed and 38 per cent. of these cases died; whereas in forty-one cases, *i. e.*, 80 per cent., of those in which drainage was not employed or was not mentioned, death occurred. The injured pancreatic tissue has been turned in and the opposed pancreatic peritoneal surfaces have been brought together with deep sutures in order to prevent leakage of pancreatic juice, but when necrosis of the sutured tissue results, this object is defeated.

The relation of diabetes mellitus to the pancreas, first demonstrated by the experiments of von Mering and Minkowski, is of special interest to the surgeon for two reasons: (1) the presence of diabetes mellitus caused by lesions of the pancreas, such as gangrenous pancreatitis or a cyst, may affect the result of operations undertaken for these conditions; (2) when a part of the gland is removed at operation,

¹ Doberauer, G.: "Ueber die sogenannte akute Pankreatitis," *Beit. z. klin. Chir.*, 1906, xlviii, 456.

diabetes may follow, because the part which remains is insufficient to accomplish the normal function of the gland.

The occurrence of glycosuria in association with pancreatic disease indicates that the lesion is far advanced and implicates almost the entire gland. The prognosis in such cases is grave. The tendency to infection is increased when diabetes complicates operations performed upon the diseased gland, but not infrequently operative interference offers the only possibility of benefit and should be undertaken. A patient of Gessner¹ with diabetes lived five months after an operation for gangrenous pancreatitis. Diabetes is usually a terminal event, and a case of Riegner² is exceptional, because slight glycosuria disappeared after operation.

When operation is performed upon the gland, preservation of as much pancreatic tissue as possible is of great importance. Experiments of Minkowski³ showed that when a fourth or a fifth of the gland remained in dogs glycosuria failed to appear; if, however, only an eighth or a twelfth remained, alimentary glycosuria appeared. The limit of functional sufficiency in man is not defined, and particularly when the gland is the seat of disease it may readily be encroached upon. In a case of Zweifel⁴ the entire pancreas save a part of the head, three centimeters in length, was resected; glycosuria appeared after operation. In some instances diabetes has followed weeks or even months after operation, and has doubtless been the result of a progressive lesion of the gland. Occlusion of the pancreatic duct does not cause glycosuria, but produces chronic interstitial inflammation of that part of the gland which is drained by the occluded duct, with the formation of dense, scar-like, connective tissue. The histologic structures known as islands of Langerhans, at first spared by the lesion, are finally implicated, and diabetes results. Especially when the head of the gland is the seat of operation, injury or occlusion of the duct of Wirsung must be avoided.

FAT NECROSIS.

The occurrence of characteristic foci of fat necrosis distributed in the fat of the omentum and mesentery not infrequently offers to the surgeon who has opened the abdomen the first suggestion of the existence of pancreatic disease. The lesion was first adequately described by Balser⁵ as an often fatal disease causing sequestration and necrosis of the pancreas. The somewhat indefinite symptoms which have been ascribed to it are those of the primary disease of which it is a consequence in much the same way that jaundice is the result of various diseases of the liver.

Foci of fat necrosis occur in the fat about the pancreas, in the omentum, in the

¹ Gessner: "Ueber Pankreasnekrose," Deutsche Zeit. f. Chir., 1899, xlv, 65.

² Riegner, O.: "Zur Diagnose und Operation der Pankreascysten," Berliner klin. Woch., 1890, xxvii, 957.

³ Minkowski, O.: "Ueber den Diabetes mellitus nach Exstirpation des Pankreas," Arch. f. exper. Path. u. Phar., 1893, xxxi, 85.

⁴ Zweifel, P.: "Exstirpation einer Pankreascyste, Heilung der Kranken," Cent. f. Gynäk., 1894, xviii, 641.

⁵ Balser: "Ueber Fettnekrose," Virchow's Arch., 1882, xc, 520.

- mesentery, and in the fat in other situations, as sharply defined, opaque white or yellowish areas in sharp contrast to the translucent fat in which they are embedded; they are often surrounded by a narrow hemorrhagic zone. They are usually rounded in shape and vary from minute points to patches half a centimeter or more in diameter, and are distinguishable from caseous tubercles or from metastases of carcinoma by the absence of elevation due to the presence of newly formed tissue; they give the impression that fat itself has undergone transformation.

Such foci occur in greatest abundance about the pancreas, where they may be confluent. They may be widely distributed throughout the abdomen, occurring in the fat below both the visceral and parietal peritoneum. Fat necrosis, when widely distributed in the abdomen, occurs in rare instances below the pleura and pericardium and even in the subcutaneous fat, causing in one instance localized injection of the overlying skin noticed during life (Hansemann¹).

Pathogenesis.—Histologic studies of R. Langerhans² have shown that the fat of the necrotic cell is split into fatty acid, which is deposited in crystalline form, and glycerin, which undergoes absorption. The lesion may be produced in animals by the injection of emulsions of pancreatic tissue, whereas a variety of injuries which allow the escape of pancreatic juice into the tissues about the gland are followed by appearance of fat necroses (Hildebrand³ and Dettmer⁴ and others). These facts have suggested the probability that the lesion is caused by penetration of the fat-splitting enzyme of the pancreatic juice, perhaps aided in its action by trypsin, about the pancreas; Flexner has demonstrated the presence of steapsin. If the pancreatic ducts of the cat are ligated, widespread necrosis of almost the entire abdominal fat results within about four weeks; if after duct-ligation pilocarpin, which stimulates secretion of pancreatic juice, is administered, death occurs with equally widespread fat necrosis at the end of several days (Opie⁵). Fat necrosis caused by the escape of pancreatic juice into the tissues about the pancreas is a manifestation of pancreatic disease in the same way that bile-staining of tissue indicates biliary obstruction.

Surgical Significance.—In man fat necrosis more frequently accompanies hemorrhagic and gangrenous pancreatitis than other lesions of the gland, and when widespread indicates with few exceptions the presence of this disease. Suppurative pancreatitis is less frequently followed by the lesion. Fat necrosis may accompany obstruction of the pancreatic ducts caused by gall-stones, carcinoma, or other cause, but in such cases the lesion is usually limited to the tissues about the pancreas.

Characteristic foci of fat necrosis are recognized when the abdomen has been opened for the purpose of exploration or when acute hemorrhagic pancreatitis has

¹ Hansemann: Discussion—*Berliner klin. Woch.*, 1889, xxvi, 1115.

² Langerhans, R.: "Ueber multiple Fettgewebsnekrose," *Virchow's Arch.*, 1890, cxxii, 252.

³ Hildebrand: "Ueber Experimente zur Erzeugung von Fettnekrosen," *Cent. f. Chir.*, 1895, xxii, 297.

⁴ Dettmer: "Die Fettgewebsnekrosen," *Inaug. Diss. Göttingen*, 1895.

⁵ Opie, Eugene L.: "Contributions to the Science of Medicine. Dedicated to Wm. H. Welch," *Johns Hopkins Hospital Reports*, 1900, ix, 859.

caused a mistaken diagnosis of intestinal obstruction, and may give the first indication of disease of the pancreas. That the lesion may disappear is shown by cases in which fat necrosis observed at operation has been absent at a second operation undertaken several months later.

ACUTE HEMORRHAGIC PANCREATITIS.

The lesion known as acute hemorrhagic pancreatitis, which is characterized by widespread necrosis of the pancreatic tissue and by hemorrhage into and about the gland, has little analogy among diseases of other organs, for the reason that its occurrence is dependent upon the peculiar physiology of the pancreas. So-called gangrenous pancreatitis represents a late stage of the hemorrhagic lesion; hemorrhagic and necrotic tissue undergoes changes probably due both to the pancreatic enzymes and to invading bacteria and assumes an appearance usually described as gangrenous. Bacteria invading from the duodenum may cause suppuration, which usually extends to the lesser peritoneal cavity, but the hemorrhagic and gangrenous lesion is distinguishable both in origin and in its subsequent course from primary suppurative pancreatitis, which does not materially differ from abscess of other organs. This distinction was first pointed out by Fitz,¹ and has been neglected by those who for convenience of clinical grouping classify all pancreatic inflammation as acute, subacute (*e. g.*, gangrenous pancreatitis), and chronic.

The occurrence of hemorrhage into the pancreas, or pancreatic apoplexy, analogous to cerebral apoplexy, has been much discussed; such hemorrhage has some medicolegal interest, since it has been believed to be a cause of sudden death. Hemorrhage caused by traumatism or by malignant growth presents nothing peculiar to the organ. Recent literature contains no well described cases of so-called pancreatic apoplexy, and increased knowledge of the etiology and pathogenesis of acute hemorrhagic pancreatitis have furnished evidence that necrosis of the pancreatic parenchyma and of blood-vessels, hemorrhage, and inflammatory changes occur side by side. Acute hemorrhagic and gangrenous pancreatitis will be described as one disease, since the gangrenous lesion represents a late stage of the former.

Etiology.—Acute hemorrhagic pancreatitis occurs more frequently in men than in women, the proportion being about two to one; with few exceptions the disease occurs between the ages of twenty and fifty years. Individuals in good health are occasionally attacked by the disease; obesity is believed to favor its occurrence. In about half the cases the disease is preceded by attacks of indigestion accompanied by pain referred to the stomach or attributed to biliary colic. In some instances there has been evidence of gastroduodenitis, but it is not improbable that this condition is secondary to the pancreatic lesion.

Acute hemorrhagic pancreatitis characterized by necrosis of tissue with hemorrhage, and accompanied by disseminated fat necrosis, has been reproduced in

¹ Fitz, R. H.: "Acute Pancreatitis," *Med. Record*, 1889, xxxv, 197, 225, 253.

animals by the injection into the pancreatic duct of a variety of substances, such as acids and alkalies, bacterial cultures, etc., all of which act as irritants and injure the secreting parenchyma of the gland. It is not improbable that the enzymes of the pancreas, particularly trypsin, acting upon tissues injured by the irritant, have an important part in the pathogenesis of the lesion. Hlava has shown that artificial gastric juice injected into the duct causes the lesion in animals.

The frequent association of cholelithiasis with acute hemorrhagic pancreatitis has directed attention to the close relation which exists between the biliary and the pancreatic ducts; Opie¹ in 1901 collected from the literature thirty-two cases of acute pancreatitis with gall-stones in eight instances impacted in the lower part of the common bile-duct. A case observed later disclosed a mechanism which has explained this association. In an individual who died nine days after the onset of acute hemorrhagic pancreatitis a small gall-stone was found at the orifice of the diverticulum of Vater. The calculus, being of small size, only partially filled the diverticulum, so that the common bile-duct was made continuous with the duct of Wirsung, which was stained with bile. Experiments upon dogs showed that bile injected into the pancreatic duct caused acute hemorrhagic pancreatitis with fat necrosis. Bunting² has recently observed a case almost identical with that just cited.

A small number of cases show that acute hemorrhagic and gangrenous pancreatitis may follow traumatism, such as the kick of a horse, in the epigastric region (Selberg³). Mechanical injury to the tissue of the gland, perhaps with thrombosis and occlusion of blood-vessels, acting in association with the enzymes of the gland may be responsible for the lesion.

Experiments of Guleke⁴ and of Doberauer indicate that symptoms of the disease are referable to toxic products of the altered or necrotic glandular tissue, and Egdahl⁵ has recently furnished evidence that products of pancreatic autolysis depressing blood-pressure may have considerable toxicity.

Stage of Hemorrhage.—Sudden onset is a feature of most cases of the disease; there is intense epigastric pain in an individual who has perhaps suffered with previous attacks of abdominal pain referred to the stomach or to biliary colic. In a smaller number of instances the disease attacks individuals who have previously enjoyed good health. Pain is localized above the umbilicus perhaps to the left of the mid-line, and is usually of great severity. Pain is accompanied by vomiting, which may recur at short intervals. Symptoms of shock accompany the pain and vomiting. There is profound weakness and depression of circulation with accelerated pulse and in some instances cyanosis.

¹ Opie, Eugene L.: "Cholelithiasis and Disease of the Pancreas," Amer. Jour. of the Med. Sciences, 1901, cxxi, 27. Bull. of the Johns Hopkins Hospital, 1901, xii, 182.

² Bunting, C. H.: "A Case of Acute Hæmorrhagic Pancreatitis," Bull. of the Johns Hopkins Hospital, 1906, xvii, 265.

³ Selberg: "Traumatische Pankreasnekrose," Berliner klin. Woch., 1901, xxxviii, 923.

⁴ Guleke, N.: "Ueber die experimentelle Pankreasnekrose," Arbeit a. d. chir. Klin. d. König. Univ. Berlin, 1906, xviii, 368.

⁵ Egdahl: "Intravenous Injections of Pancreatic Tissue," Jour. of Exper. Med., 1907, ix, 385.

The abdomen is rigid and tender and often distended, especially in the epigastric region; a tumor is rarely, if ever, palpable. In approximately one-half of the cases there is constipation, which is often relieved spontaneously or as the result of enemata about the fourth day of the attack. The stools may be clay-colored and jaundice has been present in a considerable proportion of cases. Fever is rarely present until secondary changes have occurred in the diseased gland. Leukocytosis has been found. Acute hemorrhagic pancreatitis is not commonly accompanied by glycosuria because the disease rarely affects the entire gland.

With severe collapse death occasionally occurs within twenty-four hours; a large proportion of cases are fatal within four or five days, and the pancreas presents the typical lesion of acute hemorrhagic pancreatitis; the gland is enlarged and in sharply defined areas the tissue has assumed a dark red, often reddish-black color; hemorrhage has occurred in and about the gland, the lesser peritoneal cavity often containing blood-stained fluid. Microscopic examination shows that the affected tissue has undergone complete necrosis, destroying the glandular parenchyma, interstitial tissue, and blood-vessels. There is evidence of inflammatory reaction, especially at the margin of the necrotic areas. About the pancreas and often widely disseminated throughout the abdominal cavity are conspicuous foci of fat necrosis.

Stage of Gangrene.—In about one-half of the cases the disease, often less severe in onset, pursues a more chronic course, lasting weeks or even months. In such cases the necrotic and hemorrhagic tissue becomes soft, black, and gangrenous in appearance. Infection of the injured tissue is followed by suppuration within and about the gland, which occasionally undergoes complete sequestration. Accumulation of purulent fluid containing necrotic tissue and partially disintegrated fat is a constant result of so-called gangrenous pancreatitis.

The violent symptoms which occur with the onset of acute hemorrhagic pancreatitis diminish in intensity; pain in the epigastrium persists and may be accompanied by vomiting. The transition from so-called hemorrhagic to gangrenous pancreatitis usually occurs during the second week, and is indicated by symptoms of inflammation within the lesser peritoneal cavity. The temperature is elevated, reaching perhaps 104° F., and there may be chills, though occasionally there is no fever. There is leukocytosis. A tumor referable to accumulation of exudate in the lesser peritoneal cavity is usually present in the epigastric region, extending toward the spleen, but is, as a rule, ill-defined and varies much in size. In some cases suppuration within the lesser peritoneal cavity causes erosion of the tissue over the left kidney and swelling below the left costal margin in the back. Fatty stools and glycosuria are rarely present to suggest pancreatic disease. Jaundice occurs in about a fifth of the cases.

Diagnosis.—Acute hemorrhagic pancreatitis, when accompanied at the onset by constipation, is frequently mistaken for intestinal obstruction and operation has been undertaken repeatedly for the relief of this condition. The severity of pain and its localization in the epigastrium, together with the intensity of collapse, may

suggest pancreatic disease; the stercoraceous vomiting and the visible peristalsis of intestinal obstruction are absent.

The frequent association of gall-stone colic with acute pancreatitis increases the difficulties of differential diagnosis. Intensity of pain in the epigastric region, perhaps to the left of the median line, in association with profound collapse may point to disease of the pancreas in an individual who has suffered with attacks of typical biliary colic.

Several weeks after the onset of symptoms a palpable tumor situated between the stomach and colon suggests the presence of exudate within the lesser peritoneal cavity and indicates pancreatic gangrene, if there is a history of the acute onset previously mentioned.

SUPPURATIVE PANCREATITIS.

Abscess of the pancreas, unlike hemorrhagic pancreatitis, presents little that is peculiar to the gland, and may be the result of bacterial invasion from the duodenum by way of the pancreatic duct, of extension from an adjacent organ or, very rarely, of generalized pyemia by way of the blood-vessels. The normal pancreatic duct is well protected from entrance of duodenal contents, but obstruction of the duct by carcinoma, by pancreatic calculi, or by gall-stones, often associated with inflammation of the bile-passages, may favor the entrance of pyogenic micro-organisms and cause suppuration. Ascending infection of the unobstructed duct doubtless occurs. Suppuration may produce a localized abscess or may affect diffusely the entire gland. Fitz pointed out that suppurative pancreatitis is accompanied by fat necrosis less frequently than hemorrhagic and gangrenous pancreatitis.

The necrotic and hemorrhagic tissue which is present with acute hemorrhagic pancreatitis is especially susceptible to bacterial invasion, and suppuration both of the diseased pancreas and of the overlying lesser peritoneal cavity occurs. In some instances it is impossible to determine at operation, or even at autopsy, if abscess formation has been preceded by hemorrhagic pancreatitis.

Symptoms.—In about one-half of the instances of suppurative pancreatitis the onset occurs with intense vomiting, pain, and profound collapse suggesting hemorrhagic inflammation of the gland. The symptoms diminish in severity and the disease tends to pursue a chronic course, often lasting several months. In a somewhat smaller group of cases the onset is gradual; there is epigastric pain or perhaps ill-defined discomfort, together with symptoms referred to as indigestion. Symptoms which give evidence of suppuration are fever, leukocytosis, and an epigastric tumor. Elevation of temperature is usually moderate, and occasionally the temperature has been normal or subnormal, and there has been little to suggest suppuration.

The presence of a tumor mass between the stomach and the colon, definable often with difficulty, gives the first indication for operation, which alone offers an opportunity for recovery. A palpable tumor is caused by accumulation of purulent

fluid in the lesser peritoneal cavity, which almost invariably occurs as the result of pancreatic suppuration. Other sequelæ are thrombosis of the portal and splenic veins, abscess of the liver, perforation into stomach or intestine, and general peritonitis.

CHRONIC INTERSTITIAL PANCREATITIS.

Chronic interstitial pancreatitis is not an uncommon disease, but is rarely accompanied by symptoms which make its recognition possible during life.

Etiology.—The disease is somewhat more frequent in men than in women, and, like hepatic cirrhosis, is a disease of middle life, occurring usually after the age of forty years. Ligation of the pancreatic ducts in animals is followed by chronic pancreatitis, and in a large proportion of the human cases chronic inflammation of the gland is the result of duct obstruction caused by carcinoma or a cyst compressing the duct, by pancreatic calculi within the duct of Wirsung, or by biliary calculi occupying the lower part of the common bile-duct, where it comes into contact with the main duct of the pancreas. Riedel¹ first directed attention to induration of the head of the pancreas observed at operations undertaken for the removal of gall-stones, and showed that it is caused by chronic inflammation of the gland. A small calculus lodged in the diverticulum of Vater may divert bile into the pancreatic duct and cause acute hemorrhagic pancreatitis, but a large calculus in the same situation occluding the duct of Wirsung causes chronic inflammation.

Pathology.—Chronic pancreatitis which has its origin in changes within the ducts tends to destroy the secreting parenchyma of the gland and is associated with an increase of tissue between the lobules. A second type of chronic inflammation, of which the etiology is not readily defined, affects the tissue more diffusely, so that individual acini are separated by newly formed interstitial tissue. Histologic studies have served to indicate what type of chronic pancreatitis is accompanied by diabetes mellitus. With the interacinar lesion which invades the peculiar structures known as islands of Langerhans glycosuria is present, but with the interlobular type which tends to spare these bodies glycosuria occurs only when the lesion is far advanced. Hence diabetes mellitus accompanies carcinoma compressing the pancreatic duct and pancreatic calculi only when the resultant chronic interlobular pancreatitis is far advanced.

Surgical Significance.—Certain indefinitely definable symptoms, such as pain in the epigastric and mid-scapular regions, vomiting, emaciation, and weakness, have been attributed to chronic inflammation of the gland, but they do not make its recognition possible. Of considerable significance for the surgeon is the frequent association of cholelithiasis and chronic pancreatitis with induration of the head of the pancreas, which observed at operation has not infrequently been mistaken for carcinoma and has suggested a grave prognosis not verified by the subsequent course of the disease.

¹ Riedel: "Ueber entzündliche vergrößerungen des Pankreaskopfes," Berliner klin. Woch., 1896, xxxiii, 1, 32.

CYSTS.

Cysts of the pancreas have been classified as (1) true cysts derived from the ducts or from the secreting cells of the gland and consequently lined by epithelium; and (2) pseudocysts, which have no epithelium and are limited by thickened connective tissue. Among pseudocysts which may be formed by degeneration and softening of pancreatic tissue have been included a variety of diverse lesions; such cysts, derived from the gland, may after rupture of pancreatic tissue communicate with the lesser peritoneal cavity, the walls of which undergo thickening. In many instances, particularly when cysts have been observed at operation, it has been impossible to determine whether accumulation of fluid within the lesser peritoneal cavity has had its origin in the pancreas; in some instances encapsulated blood or inflammatory exudate within the bursa omentalis has been mistaken for a pancreatic cyst.

According to Körte,¹ cysts of the pancreas may occupy a variety of situations which depend upon the relation of different parts of the gland to surrounding organs: (1) In most instances the cyst growing forward presents upon the abdominal wall between the stomach and colon, being covered by the gastrocolic omentum, which must be divided at operation. Pseudocysts arising from the pancreas and occupying the lesser peritoneal cavity after closure of the foramen of Winslow have this situation. (2) A cyst arising from the upper border of the pancreas may push its way between the lesser curvature of the stomach, which is pushed downward, and the liver, being covered by the much-stretched gastrohepatic omentum. (3) The cyst, especially when it is situated in the tail of the pancreas, may grow into the mesocolon, separating its layers. If the cyst distends the upper layer of the membrane, the colon is pushed downward and the tumor during life is found between the stomach and the colon; if, on the contrary, the lower layer is distended, the transverse colon may be found along its upper border.

Etiology and Pathology.—Pancreatic cyst is about equally frequent in men and in women, and in the greater number of cases occurs between the ages of twenty and forty years. Retention cysts due to occlusion of ducts are usually of small size and are unaccompanied by distinctive symptoms; such cysts have been described by Virchow as *ranula pancreatica*, and when of small size and multiple, by Klebs as *acne pancreatica*. Cysts of large size have been associated with pancreatic calculi and have been perhaps due to obstruction of the pancreatic duct by an impacted calculus.

The occurrence of multilobular cysts and the presence of papillary projections upon the inner surface of cysts have afforded evidence that such cysts resemble tumors, being formed by proliferation of epithelial cells (proliferation cysts). In many of these cases the nature of the cyst is doubtful, but in a few instances the new-growth resembles the cystadenomata of the ovary and contains papillary ingrowths.

¹ Körte, W.: "Pankreaserkrankungen," Deutsche Chirurgie, Stuttgart, 1898.

With many cysts of the pancreas there is a history of trauma, often preceding immediately the appearance of an abdominal tumor; forty-one cases are cited by Lazarus. Nevertheless the presence of blood frequently found in pancreatic cysts does not give evidence of such origin, since hemorrhage may occur after cyst-formation. There is, however, abundant evidence that pseudocysts may occur both as the result of traumatism in the region of the pancreas and of acute hemorrhagic pancreatitis. In both instances, doubtless, necrosis and softening of tissue are followed by accumulation of fluid; blood may disappear from the contents of these cysts.

The presence in cystic contents of one or more enzymes resembling those of the pancreas was formerly believed to give proof that a cyst had its origin in the pancreas. Not infrequently one, or perhaps all, of these enzymes are absent in the contents of a pancreatic cyst, whereas fat-splitting, diastatic or proteolytic enzymes are found in fluids not derived from the pancreas.

Symptoms.—The size and situation of the tumor caused by cysts of the pancreas are so variable that recognition is frequently difficult. A rounded, fluctuating tumor in the epigastric region behind the stomach, especially when in large part to the left of the mid-line, should suggest this lesion. The tumor is often the size of a man's head and is usually smooth and spherical, but may distend the entire abdominal cavity. Occasionally the cyst is so tense that it appears to be solid. Though usually fixed, it may be somewhat movable, especially when it arises from the tail of the gland.

The relation of the tumor to the stomach and colon is most readily determined after inflation of these organs. The stomach usually covers small cysts, but with increase of size the viscus is pushed upward and its tympany separates the tumor from the hepatic dullness. The colon lying along the lower border of the tumor may be pushed downward to the symphysis. Cysts presenting above the stomach produce dullness in contact with the liver, the stomach lying below the tumor. With cysts occupying the mesocolon the colon may be found above, below, or across the tumor.

Disappearance of pancreatic cysts has been repeatedly described. In some instances it follows rupture into the peritoneal cavity; in several cases disappearance has been accompanied by temporary diarrhea of a character which has suggested evacuation into the intestine.

Pain and other symptoms, namely, indigestion and vomiting, jaundice, ascites, etc., are referable to pressure upon adjacent organs. There is usually weakness and loss of weight. Fatty stools due to occlusion of the pancreatic ducts have been associated with cyst in only two of the cases collected by Fitz.¹ Diabetes has been associated with cyst in few cases, and indicates that destruction of the pancreas by resulting chronic inflammation is far advanced.

Diagnosis.—The differential diagnosis of pancreatic cyst is at times difficult.

¹ Fitz, R. H.: "The Pancreas and Pancreatic Diseases: Symptomatology and Diagnosis." Trans. of the Cong. of Amer. Phys. and Surg., 1903, vi, 36.

Echinococcus cyst of the left lobe of the liver may be mistaken for a cyst presenting above the abdomen; the stomach when distended tends to cover the pancreatic, but not the hepatic cyst, which is in contact with the abdominal wall. Cysts of the mesentery, unless fixed by adhesions, are found near the umbilicus and are freely movable; cysts of the mesocolon are indistinguishable from cysts of the pancreas in the same situation.

Pancreatic cysts arising from the tail of the pancreas and situated in the mesocolon may lie in contact with the pelvis and be mistaken for ovarian cysts; large cysts of the pancreas filling the entire abdomen may cause the same error. With pancreatic cyst there is a history of epigastric origin, the tumor is situated behind the stomach and colon, and the uterus is not dragged upward, the ovaries being perhaps palpable.

Puncture of pancreatic cyst for purposes of diagnosis is inadvisable.

CARCINOMA.

Malignant growth primary in the pancreas occurs, according to statistics of Bashford, once among sixty-four instances of cancer in man and among one hundred and seven in women. Carcinoma is far more common than sarcoma. Cancer usually occurs during middle life, but has been observed as early as two years. The tumor is usually situated in the head of the gland, which has been affected eighty-two times among one hundred and thirteen instances of primary growth collected by Miraillié.¹ The entire gland may be implicated. Since the pancreas is frequently invaded by carcinoma of the stomach and occasionally by tumors of the duodenum or of the bile-passages, the origin of a tumor of the pancreas may be doubtful. The tumor is usually hard and of the scirrhus type, but cellular or encephaloid cancers occur. Benign adenomata unassociated with cyst formation have been described, but such tumors are usually of small size and have little clinical interest.

Symptoms.—Pain in the epigastrium is an almost constant symptom of pancreatic cancer, but varies much in situation, character, and intensity. In many instances it is of great severity, increasing continuously until death, whereas it may be intermittent or colic-like. The deep-seated tumor mass is palpable in not more than a fourth of the cases; it is usually present in the epigastrium, but may be felt in the right or in the left hypogastrium. The mass is usually immovable, but occasionally it moves with respiration or transmits aortic pulsation.

Symptoms referable to the stomach, such as discomfort after eating, nausea, and vomiting are usually present, and in some instances compression of the pylorus may cause dilatation of the stomach. Constipation or diarrhea may be present; obstruction of the intestine may be the result of pressure. Jaundice due to the compression of the common bile-duct is frequently present, since the tumor is usually situated in the head of the pancreas; it appears suddenly and steadily increases in

¹ Miraillié: "Cancer primitif du pancréas," *Gaz. des hôp.*, 1893, No. 94.

intensity. Though the rule suggested by Courvoisier¹ is not without exceptions, dilatation of the gall-bladder is much more common when the common bile-duct is obstructed by carcinoma than when obstruction is due to cholelithiasis, with which there is usually inflammatory changes causing contraction. The liver, which in most cases fails to show the enlargement which accompanies hepatic cancer, may be enlarged as the result of metastasis.

Occlusion of the pancreatic duct may be associated with digestive disturbances due to lack of pancreatic juice in the intestine. In less than a tenth of the cases there are fatty stools or impaired digestion of meat with undigested muscle fibers in the feces. Bulky stools suggest pancreatic disease (Oser²). Diabetes mellitus accompanies cancer of the pancreas in a considerable proportion of cases, and results when the pancreas is in large part destroyed by invasion and by advanced chronic inflammation due to occlusion of ducts; Pearce has found lesions of the islands of Langerhans.

Diagnosis of cancer of the pancreas will depend upon the presence of jaundice appearing gradually, steadily increasing, and attaining great intensity, dilatation of the gall-bladder, tumor in the epigastric region, cachexia, and advanced age. One or more of these symptoms may be absent, but without jaundice or tumor a diagnosis is scarcely possible. Symptoms of impaired pancreatic function, namely, glycosuria or fatty stools, when present, confirm the diagnosis.

PANCREATIC CALCULUS.

Pancreatic lithiasis is an uncommon disease, occurring only twice among fifteen hundred autopsies at the Johns Hopkins Hospital; it is almost five times as frequent in men as in women, and occurs usually between the ages of thirty and fifty years.

Little is known concerning the cause of calculus formation within the pancreatic ducts, but stagnation of secretion and bacterial infection of the pancreatic ducts doubtless afford favorable conditions, for calculi are not infrequently found within pancreatic cysts, and biliary and pancreatic lithiasis in a considerable proportion of cases are associated.

Pathology.—Pancreatic stones are usually multiple and vary in size from small sand-like particles to masses several centimeters in diameter. Chemical examination shows the presence of calcium carbonate, calcium phosphate, magnesium carbonate, and in small proportion other inorganic salts, together with a small amount of organic matter; cholesterin may be present. The absence of bile-pigment and of bile-salts may give indication of the nature of a calculus passed with the feces.

Occlusion of the pancreatic ducts by calculi causes chronic interstitial inflammation of the gland, which is interlobular in type and causes diabetes mellitus only when far advanced.

¹ Courvoisier, L. G.: *Beit. z. Path. u. Chir. der Gallenwege*, Leipzig, 1890.

² Oser, L.: "Die Erkrankungen des Pankreas," *Nothnagel's Spec. Path. u. Ther.*, Wien, 1898.

Abscess due to suppuration about a pancreatic calculus may be a dangerous complication; rupture has occurred into the peritoneal cavity or into the duodenum.

Symptoms.—Stones within the pancreatic ducts may cause no symptoms. Pain is usually present and may be continuous or intermittent. Pancreatic colic analogous to biliary colic occurs during the passage of a calculus, but is an inconstant feature of the disease and is scarcely distinguishable from biliary colic. Jaundice may be caused by the passage of a calculus through the diverticulum of Vater.

Diagnosis.—Diagnosis of pancreatic lithiasis in four cases collected by Kinnicutt¹ was made by finding in the feces calculi composed of calcium carbonate or phosphate and containing no bile-pigment nor other constituent of the bile. Passage of such calculi may follow attacks of colic referable to the pancreas.

Glycosuria has been present in thirty-six of eighty cases of pancreatic lithiasis collected by Lazarus²; in some instances alimentary glycosuria has been observed. Steatorrhea was present in ten of the cases of Lazarus.

When calculi are not discoverable in the feces, diagnosis is rarely possible. In a case of Lichtheim³ colic with vomiting was unaccompanied by jaundice, and the presence of diabetes mellitus indicated disease of the pancreas.

SURGICAL TREATMENT OF DISEASES OF THE PANCREAS.

BY STEPHEN H. WATTS, M.D.

Historical.—While the surgery of the pancreas has hardly kept pace with our knowledge of its pathology and physiology, and while it probably remains the most incomplete chapter in the surgery of the abdomen, there has nevertheless been a gratifying progress in the operative side of the subject in recent years. The tardy development has been attributed by Mikulicz⁴ to the topographic relations of the organ, the difficulties of diagnosis, and the dangers of operations upon it; the last being due to: (a) the richness of its blood-supply and the consequent difficulty in controlling hemorrhage; (b) to the discharge of pancreatic secretion with the production of fat necroses.

Although operations upon the pancreas had been previously reported by Bozeman, Kulenkampff, Gussenbauer, and others, the surgery of the pancreas may be said to date from the work of Senn,⁵ which was published in 1885. An extensive

¹ Kinnicutt: "Pancreatic Lithiasis, with Report of a Case," *Trans. of the Assoc. Amer. Phys.*, 1902, xvii, 80.

² Lazarus: *Beitrag zur Pathologie und Therapie der Pankreaserkrankungen*, Berlin, 1904.

³ Lichtheim: "Zur Diagnose der Pankreasatrophie durch Steinbildung," *Berliner klin. Woch.*, 1894, Bd. xxxi, Nr. 8, 185.

⁴ Mikulicz, Joh. von: "Surgery of the Pancreas," *Transactions of the Congress of American Physicians and Surgeons*, 1903, vi, p. 55.

⁵ Senn, Nicholas: "The Surgical Treatment of Cysts of the Pancreas," *Am. Jour. Med. Sci.*, 1885, xc, 17, and "Die Chirurgie des Pankreas, gestützt auf Versuche und klinische Beobachtungen," *Volkman's Sammlung klin. Vorträge*, 1886-1890, Nr. 313.

review of the subject by Nimier¹ appeared in 1893, and in 1898 a great impetus was given to its study by the publication of Körte's splendid monograph,² to which the reader is referred for a complete bibliography to that date. The most important contribution in recent years is that of Mayo Robson,³ to whom we owe in a great measure our understanding of chronic pancreatitis.

Surgical Topography.—In most cases the pancreas is so covered by the liver, stomach, duodenum, and transverse colon that none of it is visible when the abdomen is opened; however, in certain cases, owing to variations in the size and position of these organs, more or less of the pancreas may be covered merely by the gastrohepatic or gastrocolic omentum. The size of the stomach varies with its state of fullness; when distended, it completely covers the pancreas, but in the contracted condition considerable portions of the pancreas may be exposed. When the liver is small and the stomach is contracted or in descensus, there is easy access to the pancreas above the lesser curvature of the stomach. If the stomach is small and the transverse colon is low, a large part of the pancreas may be felt through the gastrocolic omentum. The anatomic relations of the pancreas are well shown in Figs. 765, 766, 767.

To investigate the relations of the neighboring organs to the pancreas, with especial reference to the organs which cover it, Körte⁴ examined thirty bodies of persons over six years of age, the majority being those of adults. It was found that in twenty bodies the pancreas was completely covered, usually by the projecting edge of the liver and the distended transverse colon lying next to it, rarely by the dilated stomach. In ten bodies the pancreas was in places covered only by the omentum; in fact, in six of these the head of the gland was directly accessible between the edge of the liver and the low-lying transverse colon. In the same material he examined the mobility of the organ: in two a slight amount of motion was possible in the tail of the pancreas; in forty-eight it was firmly fixed in the retroperitoneal tissues.

The pancreas may be attacked transperitoneally or extraperitoneally. The methods of approach may be thus classified:

1. Transperitoneal methods.
 - (a) Through the gastrohepatic omentum.
 - (b) Through the gastrocolic omentum.
 - (c) Through the transverse mesocolon.
2. Extraperitoneal methods.
 - (a) Lateral abdominal.
 - (b) Lumbar.

The approach through the gastrohepatic omentum, which is unusual and chiefly

¹ Nimier, H.: "Notes sur la Chirurgie du Pancréas," *Revue de Chirurgie*, 1893, xiii, 617, and xiv, 584.

² Körte, W.: "Die chirurgischen Krankheiten und die Verletzungen des Pankreas," *Deutsche Chirurgie*, 1898, 45, b and d.

³ Robson, A. W. Mayo: "Pancreatitis, with Especial Reference to Chronic Pancreatitis," *Lancet*, 1900, ii, 235.

⁴ Körte: *Loc. cit.*

used for cysts which present above the stomach, is much simplified if the liver is small. The usual method, and that which exposes the entire gland, if necessary, is to make an opening in the gastrocolic omentum, which lays open the lesser peritoneal cavity (Fig. 766). Another method of approach is that through the transverse mesocolon. If the transverse colon and omentum are lifted up, the tail of the pancreas can be seen through the mesentery of the colon and exposed by making an opening in this region. The left colic artery, an important branch of the inferior mesenteric artery, should be avoided.

The organ can also be reached, without opening the abdominal cavity, by means of the lateral abdominal incision of Bardenheuer¹ or the lumbar incision of Robson.² The former is an incision extending from the tip of the twelfth rib to a line joining the anterior superior spine and the umbilicus, being directed downward and inward toward the mid-point of Poupart's ligament. The incision is carried down through the abdominal muscles to the subperitoneal tissues, the lower and anterior portion of the kidney is exposed, and, pushing the peritoneum upward and inward, a good exposure of the tail and body of the pancreas is obtained when the incision is on the left side. The exposure of the head of the pancreas by a similar incision on the right side is not very satisfactory.

The pancreas can be exposed also posteriorly by an incision in the costovertebral angle. This method has been used for the drainage of cysts and abscesses, but is not to be recommended when a good exposure of the organ is desired.

Displacements and Prolapse of the Pancreas.—Although the pancreas is usually firmly fixed in position, a number of cases are on record where it had a considerable range of mobility. Estes and Runge have reported cases in which the pancreas formed a part of the pedicle of a wandering spleen. It has been found in diaphragmatic and umbilical hernias. Of 276 cases of diaphragmatic hernia collected by Lacher, in twenty-seven the pancreas formed a portion of the hernial content. Schnitt and Rettig report cases in which it was present in congenital umbilical hernias and Rose mentions a case where it was found in an acquired umbilical hernia. In the case of Baud the pancreas was included in an intestinal intussusception.

The possibility of a prolapse of the pancreas through an abdominal wound has been disputed, but cases are recorded which prove that such a thing may occur. Körte collected eight such cases, among which were those of Kleberg, Otis, Dargan, and others. In seven cases the prolapsed portion was excised and in one it was replaced: seven recovered and one died. More recently Foy and Fontoyant have reported cases in which the prolapsed portion of the pancreas was replaced: one case recovered and one died, apparently from the results of a concomitant wound of the stomach.

The proper treatment of prolapse of the pancreas will depend upon the case. If the wound is recent and the protruding part of the pancreas is in good condition,

¹ Bardenheuer, B.: "Der extraperitoneale Explorativschnitt," Stuttgart, 1887, S. 216.

² Robson, A. W. Mayo: "Pancreatitis," Brit. Med. Jour., May 11, 1901, i, 1129.

it may be replaced after suitable disinfection; otherwise it should be excised, provided its extent is not too great. After excision or reposition a gauze drain should be placed down to the affected part of the pancreas.

Wounds of the Pancreas.—Injuries of the pancreas are quite rare. This can be accounted for by its deep situation upon the posterior wall of the abdomen, protected anteriorly by the costal margin, liver, stomach, and intestine, and posteriorly by the vertebral column, kidneys, etc. Isolated injuries are therefore extremely rare, and the wounds of neighboring organs often cause the death of the patient from shock or hemorrhage before the surgeon can interfere, or after the abdomen is opened so obscure the picture that the pancreatic injury is overlooked.

Animal experiments show that injuries of the pancreas are not in themselves fatal; in fact, as shown by the experiments of Minkowski and von Mering, total extirpation of the organ is not immediately fatal. Mugnai also found that wounds of the pancreas in animals are well borne. There has been considerable discussion as to whether or not leakage of pancreatic secretion into the peritoneum is injurious. Senn considered the secretion from a pancreatic wound to be harmless, provided it did not become infected; on the contrary, Biondi found that it could give rise to peritonitis. Hildebrandt and Dettmer showed that procedures which dam up the pancreatic secretion or cause a leakage of pancreatic fluid into the peritoneum produce a fat necrosis in the gland itself and in the surrounding tissues. Clinical experience and the experiments of Williams, Flexner, Katz, Winkler, and others confirm this observation. Mikulicz thought that the leakage of pancreatic juice reduces the resistance of the peritoneum to such an extent that bacterial invasion and peritonitis readily ensue. His statistics seem to show that the prognosis of an operation becomes much worse when the pancreas is injured. Of ninety-one cases of resection of the stomach, where the pancreas was certainly not injured, twenty-five, or 27.5 per cent., died as the result of the operation; of thirty cases in which the pancreas was more or less injured, 21, or 70 per cent., died, mostly of peritonitis. He also thought that the secretion from an injured or inflamed pancreas can cause a variety of aseptic peritonitis with paralysis of the intestine and symptoms of intestinal obstruction.

We distinguish subcutaneous and open wounds of the pancreas. The former are usually due to blows upon or crushes of the upper abdomen, which press the pancreas against the vertebral column and lacerate or even divide the organ. They are most frequently the result of horse kicks, being run over by vehicles, or being caught between cars. Penetrating wounds are usually of gunshot origin or stabs.

The diagnosis of pancreatic injuries is very difficult; in fact, there are very few cases on record in which the diagnosis has been made before operation, except certain cases operated upon several days after the injury, in which the appearance of a circumscribed area of dullness and resistance in the epigastrium following upon the acute symptoms, namely, pain and tenderness, vomiting, evidences of loss of blood, or shock, pointed to a pancreatic injury. Since isolated injuries are so rare, the picture is generally governed by symptoms due to the injury of some other organ, such

as the liver, stomach, or intestine, and in these cases the injury to the pancreas is not infrequently overlooked.

In cases of subcutaneous or penetrating wounds of the upper abdomen it is therefore important to always examine the pancreas. As Mikulicz has aptly said: "The indication for operation does not depend upon the diagnosis of an injury to the pancreas itself, but also upon the severity of all the symptoms, especially and particularly the steady accentuation of such symptoms. These symptoms are increasing anemia, the physical signs of blood in the peritoneal cavity, and peritoneal irritation. An injury to the neighboring organs can frequently occasion the same symptoms, and, as a rule, it is not important to diagnose that the pancreas itself has been injured."

Operation being decided upon, the incision is best made in the mid-line above the umbilicus or through the inner edge of the rectus muscle. It can be easily enlarged by lateral incisions, and if the exposure is still insufficient the left costal margin can be divided and retracted outward. The pancreas is exposed by an opening in the gastrocolic omentum.

If a wound is discovered in the pancreas it is important to stop the hemorrhage and prevent the spread of pancreatic fluid. This is best done by means of deep sutures of catgut and by packing. In inserting the deep sutures one should avoid injuring such important structures as the superior mesenteric and splenic vessels. If the main duct has been divided, it may be sutured, but an accurate approximation of the surrounding parenchyma will probably be sufficient. In the case of wounds produced by blunt force, where the gland is extensively crushed, sutures may be inadvisable and a large pack necessary.

In 1903 Mikulicz¹ collected forty-five cases of pancreatic injury, twenty-one penetrating wounds and twenty-four subcutaneous wounds. Of the twenty-one penetrating wounds, twelve were of gunshot origin and nine were stab wounds. Of the gunshot wounds, five were operated upon, two dying and three recovering. The seven that were not operated upon died. The nine stab wounds were all operated upon, one dying and eight recovering. The remarkably favorable percentage of recovery in stab wounds is to be explained by the fact that in seven cases the pancreatic injury was really a prolapse, and in some of the cases only a minor injury of the prolapsed portion was present. The evil consequences of injuries to the pancreas within the peritoneal cavity could therefore not follow.

Of the twenty-four subcutaneous injuries, thirteen were not operated upon and all died. Of eleven operated upon, seven recovered. The operation consisted in exposing the injured pancreas and drainage.

Since Mikulicz's publication cases of gunshot wound of the pancreas which were operated upon with recovery have been reported by Borchardt and Becker. Becker's case is the only one of isolated gunshot wound of the pancreas on record. Cases of subcutaneous wound of the pancreas which were operated upon and recovered have been reported by Garrè, Blecher, Thöle, Beneke, and others.

¹ Mikulicz: *Loc. cit.*

Among the complications and sequelæ of pancreatic injuries we may mention inflammation and abscesses, necrosis, and cysts of the pancreas, one-fourth of pancreatic cysts being said to be of traumatic origin.

Acute Hemorrhagic and Gangrenous Pancreatitis.—Although the question as to the best treatment of acute pancreatitis has been freely discussed in recent years, it is not yet settled. Many surgeons are still averse to early operation, arguing that, inasmuch as the results of operative interference are more favorable after the formation of a localized abscess, one should wait until such an abscess forms before operating. This argument, however, is fallacious, as it does not consider the large percentage of those who die before such a favorable condition is presented; and, in the second place, many patients never develop a localized abscess, the process being diffuse from the beginning.

A number of surgeons, among them Körte, who formerly advised against operation in the early stages, now advise early operation. One of the first to advise operating in the first stages of acute pancreatitis was Hahn,¹ who, considering the collapsed condition of most of these cases, recommended a small incision in the middle line below the umbilicus and drainage for evacuation of the blood-stained peritoneal fluid. He thought the high mortality after operation in such cases was to some extent due to the fact that the operation was undertaken with the mistaken diagnosis of peritonitis or intestinal obstruction, the prolonged search for the perforation or obstruction being badly borne by such weak subjects. This point has also been emphasized by Mikulicz and others. Woolsey,² who has reported three cases operated upon in a manner essentially similar to Hahn's, with recovery, recommends laparotomy and drainage, and thinks extensive and prolonged operations are not justifiable. Pels-Leusden, Wiesinger, and others have reported cases thus treated successfully.

Halsted, Pels-Leusden, and Bevan have reported cases of acute pancreatitis which recovered after laparotomy and closure without drainage. In some of these cases nothing more was done because the collapsed condition of the patient would not allow it.

The benefit derived from these methods of operating is doubtless due to the removal of the blood-stained peritoneal fluid, which is very toxic. Doberauer³ and Guleke⁴ have shown that the critical condition of patients with acute pancreatitis is due to a trypsin intoxication, the intensity of the intoxication depending upon the extent of the necrosis and the amount of pancreatic gland destroyed. Guleke has succeeded in immunizing animals against trypsin.

Mikulicz in 1903 advanced the view that acute pancreatitis should be treated as

¹ Hahn: "Ueber operativen Behandlung bei Pankreatitis hæmorrhagica," *Deutsche med. Wochenschr.*, 1901, Bd. xxvii, Vereins Beilage, i, S. 5.

² Woolsey, G.: "The Diagnosis and Treatment of Acute Pancreatitis," *Annals of Surgery*, 1903, xxxviii, 726.

³ Doberauer, Gustav: "Ueber die sogenannte akute Pankreatitis und die Ursachen des schweren oft tödlichen Verlaufes derselben," *Beit. z. klin. Chir.*, 1906, xlviii, 456.

⁴ Guleke, N.: "Ueber die experimentelle Pankreasnekrose und die Todesursache bei acuten Pankreaserkrankungen," *Arch. f. klin. Chir.*, 1906, lxxviii, 845.

any other phlegmon, and that the moment the condition is recognized the abdomen should be opened and the inflamed peripancreatic tissues and the pancreas itself incised and drained. He considered the flushing of the abdominal cavity with salt solution to be quite important. Porter¹ and Muspratt² have reported cases successfully treated by this method, deep incisions being made into the pancreas and drainage instituted.

A study of the literature reveals the striking frequency of the sequence of acute pancreatitis upon cholelithiasis, and a good many cases are recorded in which at the operation for acute pancreatitis gall-stones were found in the gall-bladder and cholecystostomy performed, the patients recovering completely. Such cases have been reported by Mayo, Nash, Lilienthal, Kelly, Robson, and others.

Henle operated upon a case in which the diagnosis of intestinal obstruction had been made. After demonstrating the presence of fat necroses in the omentum, a large peritoneal exudate was removed and an artificial anus was established in the cecum to relieve the condition of intestinal paralysis. The patient recovered and the artificial anus was subsequently closed.

I want to emphasize the importance of operating in the early stages of acute pancreatitis, before a secondary infection from the intestine renders the prognosis more unfavorable. Inasmuch as these cases are seldom diagnosed with absolute certainty, and are often mistaken for peritonitis or intestinal obstruction, the operation will usually be in the nature of an exploratory laparotomy. The discovery of blood-stained fluid and the presence of fat necroses clinch the diagnosis.

The exact nature of the operation will depend upon the condition of the patient. The ideal procedure would be about as follows: Rapid removal of the peritoneal exudate, perhaps with irrigation of the abdominal cavity with salt solution; exposure of the pancreas through the gastrocolic omentum, incision of the swollen, inflamed gland, and introduction of a large gauze tampon; examination of the gall-bladder and bile-passages; removal of calculi, if present, and cholecystostomy. As a matter of fact, such a procedure will probably seldom be warranted and must be modified to suit the case. The simplest procedure is that advocated by Hahn, namely, laparotomy and drainage of the peritoneal exudate. However, it seems to me that a rapid exposure of the pancreas and the introduction of a large tampon, perhaps with incision into the gland, will cause very little more shock and offer better prospects of cure. A larger experience will probably show which procedures will cause the smallest amount of surgical shock, while still accomplishing the object for which they are undertaken.

Mikulicz in 1903 collected forty-six cases of acute pancreatitis, which had been operated upon in the acute stage with only nine recoveries. On the contrary, eighteen out of thirty-five cases recovered when the operation was done in the later stages. He states, however, very rightly that such statistics are of very little value, for, as he

¹ Porter, C. A.: "Pancreatitis: Operation; Recovery," *Boston Med. and Surg. Jour.*, 1903, cxlix, 430.

² Muspratt, Charles D.: "Acute Hemorrhagic Pancreatitis: Operation; Recovery," *Brit. Med. Jour.*, Feb. 5, 1904, i, p. 304.

says: "First of all, we do not know from the statistics available at present how many of these patients with acute pancreatitis really survive the acute stage, and go on to the subacute, the most favorable stage for operation. I believe that comparative statistics in this regard will show that the great majority of the patients die in the acute stage. The possibility that a goodly number could be saved by a rationally conducted early operation cannot at present be denied."

Bloodgood in 1904 collected seventy-five cases of acute hemorrhagic pancreatitis, of which twenty-five recovered and fifty died. Of the twenty-five which recovered, eighteen had been operated upon, the remaining seven recovering without operation. Of the fifty which died, twenty-three had been operated upon.

In 21,000 admissions to the surgical service of the Johns Hopkins Hospital there have been only four cases of acute hemorrhagic pancreatitis. All of these were operated upon in the early stage, with one recovery. Two, including the case which recovered, were closed without drainage. In the other two a gauze tampon was placed down to the pancreas.

Pancreatic Apoplexy.—The relation which hemorrhage into the gland and hemorrhagic pancreatitis bear to one another is not very clear, and in reviewing the reported cases it is often difficult to distinguish between them. There is little doubt, however, that genuine cases of pancreatic hemorrhage without preceding inflammation of the gland do occur, but the hematoma so soon becomes infected that the case to all intents and purposes is one of acute pancreatitis, and what has just been said regarding the treatment of acute hemorrhagic pancreatitis applies also to these cases. They are quite rare, are usually rapidly fatal, and are seldom cured by surgical intervention.

Bunge¹ has reported a case of pancreatic apoplexy which recovered after laparotomy and extensive drainage of the lesser peritoneum.

I have seen two cases of pancreatic apoplexy at the Johns Hopkins Hospital which were thus treated, but both died. In one of these there was an extensive hemorrhage into the head of the pancreas and into the retroperitoneal tissues behind the ascending colon; in the other the lesser peritoneal cavity was filled with necrotic blood-clot and there were extensive infiltrations of the transverse mesocolon and into the tissues behind the descending colon.

Suppurative Pancreatitis; Pancreatic Abscess.—Those cases of acute pancreatitis which proceed to suppuration, the subacute form of Robson and Moynihan, are of particular interest, since they are especially amenable to surgical treatment. In the majority of these cases the onset is as acute as in the hemorrhagic form, but the symptoms are, as a rule, less severe, and the process is not of sufficient extent and gravity to cause death. Somewhat later the necrosis and secondary infection give rise to the formation of more or less extensive abscesses, containing larger or smaller portions of the sequestered pancreas. Considering the satisfactory results of prompt surgical intervention, the early diagnosis of these cases is very important.

¹ Bunge: "Zur Pathogenese und Therapie der acuten Pankreashämorrhagie und abdominalen Fettgewebnekrose," *Arch. f. klin. Chir.*, 1903, lxxi, 726.

especially since grave complications are prone to arise, such as liver abscess, subphrenic abscess, thrombosis of the portal vein, exhaustion, etc.

Diffuse suppuration or abscesses confined to the pancreas are seldom seen, since the pus is very liable to burrow into the peripancreatic tissues and lesser peritoneum, often giving rise to a tumor, which can be more or less clearly defined before operation and which facilitates the diagnosis. The tumor usually presents in the mid-line below the stomach, but occasionally above the stomach, or it may extend well over into the left flank, giving rise to the mistaken diagnosis of perinephritic abscess.

Spontaneous healing without operation is unusual, but cases where the diagnosis was confirmed have been recorded, in which recovery took place after the rupture of the pancreatic abscess into the intestine. Robson¹ has reported such a case, and another in which the abscess ruptured into the stomach and recovery followed a gastro-enterostomy.

Cases of diffuse suppuration or small multiple abscesses offer little hope of successful surgical treatment, but with a large localized abscess the outlook is much brighter.

The diagnosis is often not determined until the abdomen is opened. The incision is usually made in the median line or through the rectus muscle over the most prominent part of the tumor mass. If the examination shows the presence of a pancreatic abscess, the abdominal cavity is packed off with gauze and the abscess opened, usually through the gastrocolic omentum, evacuated and drained with gauze or by means of a rubber tube surrounded with gauze. It is generally preferred to complete the operation in one stage, but it can be done in two stages, the abscess first being walled off with gauze or by suturing its wall to the parietal peritoneum and opened later, after adhesions have formed.

To secure better drainage, especially when the abscess extends well toward the flank, it is sometimes advisable to make an incision in the costovertebral angle, and by blunt dissection, passing in front of the lower pole of the kidney, to open a path for drainage.

In recent years numerous cases have been reported in which recovery followed operations for pancreatic abscess. Thayer² has reported four cases operated upon by Halsted, Finney, and Bloodgood, three of which recovered. Robson³ has reported eight cases occurring in his own practice. Six were operated upon, with recovery from the operation in five, though in one of the cases the relief was only for a few weeks and in another for a few months.

Chronic Pancreatitis.—Those chronic inflammations of the pancreas arising from general causes, such as syphilis and alcoholism, and certain local causes, such as gastro-intestinal catarrh and local circulatory disturbances, are not amenable to surgical treatment, though their effect upon neighboring organs or the pancreas itself may require such treatment. Of the former, the common duct is most fre-

¹ Robson, A. W. Mayo: "Inflammatory Affections of the Pancreas," *Lancet*, 1904, i, 845.

² Thayer, Wm. S.: "Observations on Several Cases of Acute Pancreatitis," *Johns Hopkins Hosp. Bull.*, 1903, xvi, 355.

³ Robson: *Loc. cit.*

quently involved, often being so compressed by the head of the pancreas that a severe jaundice ensues. The gall-bladder is, as a rule, distended, whereas in cases of biliary obstruction due to calculi it is usually contracted.

Surgeons at first considered these to be cases of carcinoma of the pancreas and were content to do a simple exploration or else joined the distended gall-bladder to the intestine. The surprising and gratifying results in many of these cases gradually led to the adoption of a rational method of treatment, which aimed at the removal of the biliary obstruction and at the same time sought to bring about a subsidence of the inflammatory process in the head of the pancreas.

Riedel¹ in 1896 first called attention to the extremely hard tumors in the head of the pancreas due to chronic pancreatitis, emphasized their relation to gall-stones, and mentioned their chronic course, recognizing, however, that they do subside. It is to Robson,² however, that we owe the development of the surgical treatment of this condition. Since his publication the attention of surgeons has been directed to this disease and numerous cases have been reported in which recovery has followed operation.

When only mild symptoms are present, medical treatment should be given a fair trial, but the surgeon should not hesitate too long in operating for chronic pancreatitis, as serious disturbances of nutrition can result from the gradual degeneration of the gland. When the operation is done before the process has advanced to a well-marked pancreatitis or to the interacinar form, a complete cure is effected in a large proportion of the cases; but if the interstitial changes have become well marked, an arrest of the process is all that can be hoped for.

Owing to the uncertainty of the diagnosis of this condition the operation will usually be an exploratory incision through the upper part of the right rectus muscle. Even after the abdomen is opened and the pancreas palpated it is sometimes difficult to decide whether we are dealing with a chronic pancreatitis or a carcinoma of the head of the gland, though the induration produced by the former is somewhat more elastic than that produced by the latter. The gall-bladder is usually distended in either case.

If the condition is one of chronic pancreatitis any concretions present in the gall-bladder, bile-ducts, or duct of Wirsung should be removed, and at the same time the bile-ducts should be drained either by cholecystostomy or cholecystenterostomy. Even though no gall-stones or pancreatic calculi are present drainage of the bile-ducts by one of these methods is very important. According to Robson, the drainage of the bile-ducts acts not only by removing one source of irritation in the shape of infected bile, but at the same time it relieves tension and allows the escape of the infected pancreatic secretion, besides freeing the blood and the system at large from a poison which seriously damages them.

¹ Riedel: "Die chronische zur Bildung eisenharter Tumoren führende Entzündung der Schilddrüse," *Deutsche med. Wochenschr.*, 1896, xxii, V, 120.

² Robson, A. W. Mayo: "Pancreatitis, with especial Reference to Chronic Pancreatitis," *Lancet*, 1900, ii, 235; "On the Pathology and Surgery of Certain Diseases of the Pancreas," *Lancet*, 1904, i, 773.

Cholecystostomy and cholecystenterostomy both have their advantages and disadvantages. The technic of the first, which is recommended by Robson, is more simple and does not permit a permanent infection of the biliary tract from the contents of the intestine. It has the disadvantage that the patient is burdened for a long time with an external fistula, which may prove difficult to close. The experiments of Radziewski would indicate that the importance of a retrograde infection of the bile-ducts from the intestinal fistula has been overestimated. The danger of infection is lessened if, after cholecystenterostomy, an entero-anastomosis is immediately added at a distance of about 10 cm. from the original anastomosis, which deflects the intestinal contents from the loop connected with the gall-bladder. Gastro-enterostomy avoids the external fistula, but is a more extensive procedure and is attended by greater danger to the patient.

Barth¹ and Martina² have each reported a case of chronic pancreatitis in which the severe epigastric pain was relieved by incising the thickened, inflamed peritoneum covering the gland. Martina thought that in his case the relief of the pain, which was worse after taking nourishment, was due to the fact that the incision allowed the expansion of the gland, which swells after taking food, as a result of the increased blood-supply.

Robson in 1904 reported the following results of his operations for chronic pancreatitis. In twenty-seven cases of catarrhal or interstitial pancreatitis, where gall-stones were found obstructing the pancreatic portion of the common duct, choledochotomy in nineteen, cholecystostomy in five, and cholecystenterostomy in three were followed not only by immediate but by permanent recovery, except one who died later of acute bronchitis, one who has cirrhosis of the liver, and one who eight and a half years after the operation was apparently well but had sugar in the urine. In twenty-four cases where obstruction to the common bile-duct was due to an inflammatory condition of the pancreas compressing the bile-duct, though probably in many cases originally due to gall-stones, yet where gall-stones were not present at the time of operation, the bile-ducts, and thus indirectly the pancreatic ducts, were drained, in twelve cases by cholecystostomy and in nine by cholecystenterostomy; in three cases adhesions were separated and no drainage of the bile-ducts was performed. Of these twenty-four cases, twenty-two recovered, of which eighteen could be traced at the time of his report and were found to be well. We thus see that only two out of fifty-one cases died as a direct result of the operation.

Besides his own cases, fifty-one in number, Robson found sixty-two operations for chronic pancreatitis recorded, of which eight died, giving a rate of mortality of 12.9 per cent.

Pancreatic Lithiasis.—Since the presence of calculi in the pancreas may give rise to serious disturbances in the organ, such as dilatation of the duct of Wirsung,

¹ Barth: "Ueber indurative Pankreatitis," *Verh. d. Deutschen Ges. f. Chir.*, 1904, xxxiii, 376.

² Martina, A.: "Ueber chronische interstitielle Pankreatitis," *Deutsche Zeit. f. Chir.*, 1907, lxxxvii, 499.

abscess formation, and atrophy of the gland, it is important that they be recognized early and removed as soon as possible. The diagnosis is, however, difficult and seldom made with any degree of certainty. Kinnicutt,¹ in 1902, collected seven

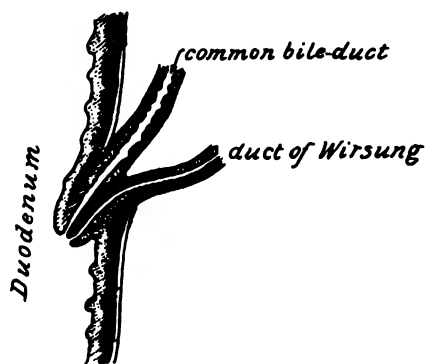


FIG. 768.—THE COMMON BILE-DUCT AND DUCT OF WIRSUNG OPENING SEPARATELY AT THE SUMMIT OF THE BILE PAPILLA.

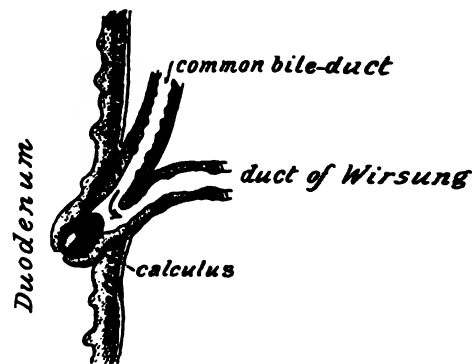


FIG. 769.—A SMALL GALL-STONE OCCLUDING THE DUODENAL ORIFICE OF THE DIVERTICULUM OF VATER AND CONVERTING THE COMMON BILE-DUCT AND THE DUCT OF WIRSUNG INTO A CONTINUOUS CHANNEL.

cases, including one of his own, in which the diagnosis was made, and since his publication several cases have been reported in which pancreatic calculi were diagnosed and removed at operation.

In Gould's case,² which was not diagnosed before operation, there was jaundice and the gall-bladder was distended. A

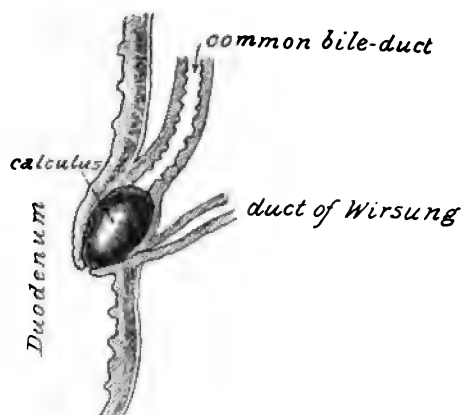


FIG. 770.—LARGE GALL-STONE LODGED IN THE DIVERTICULUM OF VATER AND OCCLUDING BOTH COMMON BILE-DUCT AND DUCT OF WIRSUNG.

large coral-like stone was removed from the duct of Wirsung, but the obstruction to the flow of bile was not removed, and there was another attack of agonizing pain in the right hypochondrium. The abdomen was again opened and another stone found in the head of the pancreas and removed by incising the pancreas over it. A probe could then be passed through the duct into the duodenum. The patient died twelve days after the operation from exhaustion. In Dalziel's case a stone, the size of a large pea, was removed from the pancreatic duct through an incision in the duodenum,

and the patient made a good recovery. Lisanti in 1899 reported a case in which recovery took place after the transduodenal removal of a stone from the duct of Wirsung.

¹ Kinnicutt, Francis P.: "Pancreatic Lithiasis, with Report of a Case," Am. Jour. Med. Sciences, 1902, cxxiv, 948.

² Gould, A. Pearce: "Pancreatic Calculi," Lancet, 1898, ii, 1632.

In Moynihan's case,¹ in which a diagnosis of chronic pancreatitis and pancreatic lithiasis had been made, a stone $\frac{1}{2}$ inch long and $\frac{3}{16}$ inch in diameter was removed from the orifice of the duct of Wirsung after incising the duodenum and laying open the ampulla. In 1903 Robson² operated upon a woman fifty-seven years old and removed four pancreatic calculi, one from the duct of Santorini by direct incision into the pancreas close to the common duct, afterward closing the opening by deep and peritoneal sutures; the second and third stones were removed by laying open the papilla through the duodenum and removing the stones from the duct of Wirsung; a fourth concretion was removed by direct pancreatotomy from the middle of the duct of Wirsung, the pancreas being exposed through an opening in the gastrohepatic ligament. The duct was closed with catgut and the wound in the body of the pancreas and the peritoneal covering were sutured without drainage. Staehlin and Roeber³ in 1905 reported the case of a woman thirty-nine years old, in whom a diagnosis of pancreatic lithiasis was made. At the operation several calculi were found in the

duct of Wirsung in the head of the pancreas and removed through an incision in the gland. Recovery followed.

Several cases are recorded where calculi were found in abscesses or cysts of the pancreas. In Caparelli's case, after many attacks of acute epigastric colic, an abscess developed above the umbilicus, which burst and discharged pus and gritty material. Through the fistula, which persisted for six years, many small stones, over a hundred in all, were expelled. After spontaneous closure of the fistula diabetes developed and the patient died. Allen⁴ found two stones in a cyst, the size of an orange, presenting above the stomach. The cyst was drained and the patient died five days later. At the autopsy a stone the size of a marble was found in the duct of Wirsung near its orifice.



FIG. 772.—A LARGE GALL-STONE OCCLUDING BOTH COMMON BILE-DUCT AND DUCT OF WIRSUNG; METHOD OF APPROACH.



FIG. 771.—LARGE GALL-STONE WHICH HAD OCCLUDED THE DIVERTICULUM OF VATER AND CAUSED CHRONIC INTERSTITIAL PANCREATITIS.

An incision through the inner edge of the right rectus muscle is probably the best for removing calculi from the pancreas, a cushion being placed beneath the

¹ Moynihan, B. G. A.: "On Pancreatic Calculus." *Lancet*, 1902, ii, p. 355.

² Robson, A. W. Mayo: "The Pathology and Surgery of Certain Diseases of the Pancreas," *Lancet*, 1904, i, p. 911.

³ Staehlin, Edward, and Wm. J. Roeber: "Clinical and Operative Reports of Cases of Biliary and Pancreatic Calculi," *New York Med. Jour.*, 1905, lxxxii, p. 904.

⁴ Allen, Lewis Whitaker: "Chronic Interlobular Pancreatitis," *Ann. Surg.*, 1903, xxxvii, p. 741.

lumbar spine to bring the pancreas nearer to the surface. The orifice of the duct of Wirsung is best explored through the duodenum by laying open the ampulla of Vater, which can be brought to the surface by grasping its edges with forceps; the duct can then be readily probed. If the calculus is situated more deeply in the ducts, it can be removed, after exposing the pancreas above or below the stomach, by incising the pancreas and duct. The duct should be sutured and the pancreatic tissue and peritoneum likewise carefully sutured. It will probably be safer in most cases to place a gauze drain down to the suture, the gauze being surrounded by rubber tissue. When the duodenum has been opened it must, of course, be carefully sutured. It is not necessary to suture the incision in the papilla.

If the calculus is felt in the deeper portions of the head of the gland, its posterior surface may be explored by dividing the reflection of peritoneum to the right of the duodenum and lifting the bowel and pancreas upward and to the left (Fig. 589). The calculus can then be extracted by incising the pancreas.

Cysts of the Pancreas.—The following are the methods of treating pancreatic cysts: (a) Puncture; (b) extirpation; (c) incision and drainage.

The *puncture* of cysts as a means of diagnosis or treatment is only mentioned in order to condemn it, for the dangers attending it are too great and the prospect of cure by this means is very remote. The dangers consist in the liability of injury to overlying viscera and blood-vessels, and the leakage of the contents of the cyst into the peritoneal cavity. Cases have been reported in which death has resulted from hemorrhage or peritonitis following this procedure.

Extirpation, which was first carried out successfully by Bozeman in 1881, is the method of choice, if it can be done without endangering the patient's life. In certain instances the cyst is bound to the surrounding structures by very few adhesions and connected to the pancreas by such a small pedicle that it can be extirpated without great difficulty. As a rule, the nearer its pedicle is to the tail of the pancreas, the easier is the removal of the cyst.

Generally, however, the cyst wall is so intimately adherent to important structures that the dangers attending its removal render such a measure inadvisable. The structures most liable to injury are the stomach, intestine, splenic and mesenteric vessels. In extirpating pancreatic cysts Mikulicz had to ligate the splenic artery and Billroth both the splenic artery and vein.

Many authors advise the total excision of cystadenomata (proliferating cysts) of the pancreas on account of the danger of their becoming malignant, though this danger is probably not a very real one. Roswell Park says: "These may sometimes evince malignancy, many of them being so close to the border-line between proliferating cystoma and cystic carcinoma that only the subsequent course of events would indicate on which side of the line they belong."

Cystadenomata have been removed by Poncet,¹ Martin,² Dunning,³ and others.

¹ Gibert: "Gros kysteglandulaire de la queue du pancréas, etc.," *Gaz. des Hôp.*, 1896, lxix, p. 347.

² Martin, A.: "Ein Fall von Pankreascyste," *Virchow's Archiv*, 1890, cxx, S. 230.

³ Dunning, L. H.: "Cystadenoma of the Pancreas," etc., *Am. Jour. Obst.*, 1905, li, p. 101.

Lazarus¹ collected twenty-four cases in which pancreatic cysts had been extirpated. Of these, eighteen recovered and six died; of ten cases in which, on account of difficulties, the cyst was only partially removed, six died, death being due to gangrene of the intestine, peritonitis, hemorrhage, or exhaustion.

Incision and drainage may be considered the normal method of dealing with cysts of the pancreas. It was done successfully by Kulenkampff in 1882 and by Gussenbauer in 1883. Its drawbacks are that the cyst occasionally recurs and that the fistula is sometimes of long duration. Statistics show that the likelihood of recurrence is very slight, except those cysts complicated by new-growths, where extirpation is often indicated.

The incision of the cyst can be done from the front by the transperitoneal route, or from behind by the extraperitoneal method (Bardenheuer). The posterior operation, which is sometimes indicated in the case of suppurating cysts of the tail of the pancreas, avoids the danger of peritonitis, but, on account of the danger of injuring large blood-vessels, the ureter, and intestine, may be technically difficult. In the case of cysts which present in the epigastrium or right hypochondrium, the exposure from the front is the simplest and most satisfactory method. The operation may be done in one stage, the cyst being attached to the abdominal wall and immediately opened and drained; or in two stages, the cyst being opened a day or two after its wall has been sutured to the parietal peritoneum. The one-stage operation is performed more frequently than the two-stage operation. According to the statistics of Körte (*loc. cit.*), of eighty-four cases operated upon in one stage, four died from the operation, four later of malignant growth, and two of diabetes; of seventeen operated upon in two stages, none died directly as the result of the operation, but one died shortly after his discharge from the hospital, presumably of diabetes. The danger of the one-stage operation is the leakage of the contents of the cyst into the peritoneal cavity, but this fluid is usually sterile, except in suppurating cysts, and, moreover, leakage into the abdominal cavity can usually be avoided if the operation is done with care.

The one-stage operation is, according to Körte's experience, the normal procedure. The skin incision will vary with the position of the cyst, but will usually lie over its most prominent portion. After opening the abdomen there are three ways of approach to the cyst: (1) Pancreatotomy supraventricularis; (2) pancreatotomy gastrocolica; (3) pancreatotomy mesocolica.

The first method, which leads through the gastrohepatic omentum, is indicated where the cyst presents between the stomach and the liver. After dividing the gastrohepatic omentum the cyst may be sutured to the abdominal wall and drained. As a rule, however, the exposure of the cyst wall above the stomach is difficult, for it is frequently intimately adherent to the stomach, liver, and even to the abdominal wall. In a case where the cyst was densely adherent to the left lobe of the liver, Rasumowsky made an opening into the cyst through the edge of the liver by

¹ Lazarus, Paul: "Beitrag zur Pathologie und Therapie der Pankreaserkrankungen, etc.," *Zeitschr. f. klin. Med.*, 1904, li, p. 101.

means of a thermocautery. Where the cyst is situated behind the stomach and adherent to its posterior wall, the exposure of the cyst may be complicated. In such a case Bessel Hagen¹ incised the anterior and posterior walls of the stomach and



FIG. 773. — EXPOSURE OF THE PANCREAS THROUGH THE GASTROCOLIC OMENTUM.

thus evacuated the cyst. After suturing the wounds in the stomach, the lower pole of the collapsed cyst was brought up, sutured to the abdominal wall and drained. The posterior route would probably be better in such cases.

¹ Bessel Hagen, F.: "Zur operativen Behandlung der Pankreascysten." Arch. f. klin. Chir., 1900, Bd. lxii, S. 157.

The *pancreatotomy gastrocolica* is adapted to cysts presenting between the stomach and transverse colon, and is the method most often employed in draining pancreatic cysts. A good exposure is obtained by dividing the gastrocolic omentum, elevating the stomach, and drawing the colon downward. After carefully suturing the cyst to the parietal peritoneum with silk or catgut, the abdominal wound may be partially closed and the cyst then opened and drained. Some condemn aspirat-



FIG. 774.—EXPOSURE OF THE POSTERIOR SURFACE OF THE HEAD OF THE PANCREAS AFTER INCISING THE PERITONEUM TO THE RIGHT OF THE DUODENUM.

ing and emptying the cyst before attaching it to the abdominal wall, since the wall of the collapsed cyst is then brought forward and sutured with difficulty.

The author has recently had a case which was treated very satisfactorily in the following manner, which is very similar to his method of treating acute cholecystitis and hydrops of the gall-bladder: The incision was made through the left rectus muscle over the most prominent portion of the tumor. The large cyst presented between the stomach and transverse colon, but was so covered by stomach that its

exposed portion was at some distance from the anterior abdominal wall, to which it could, therefore, not be sutured. The general cavity was walled off with gauze, the gastrocolic omentum was divided, and the greater part of the contents of the cyst removed by means of a large aspirating syringe; the cyst was then incised, its edges grasped with forceps (Fig. 775), and the remaining fluid wiped out with sponges. A large rubber drainage-tube covered with gauze was fastened into the opening by means of a purse-string suture of catgut and the abdominal wound closed up to the drain. The patient made an uneventful recovery.

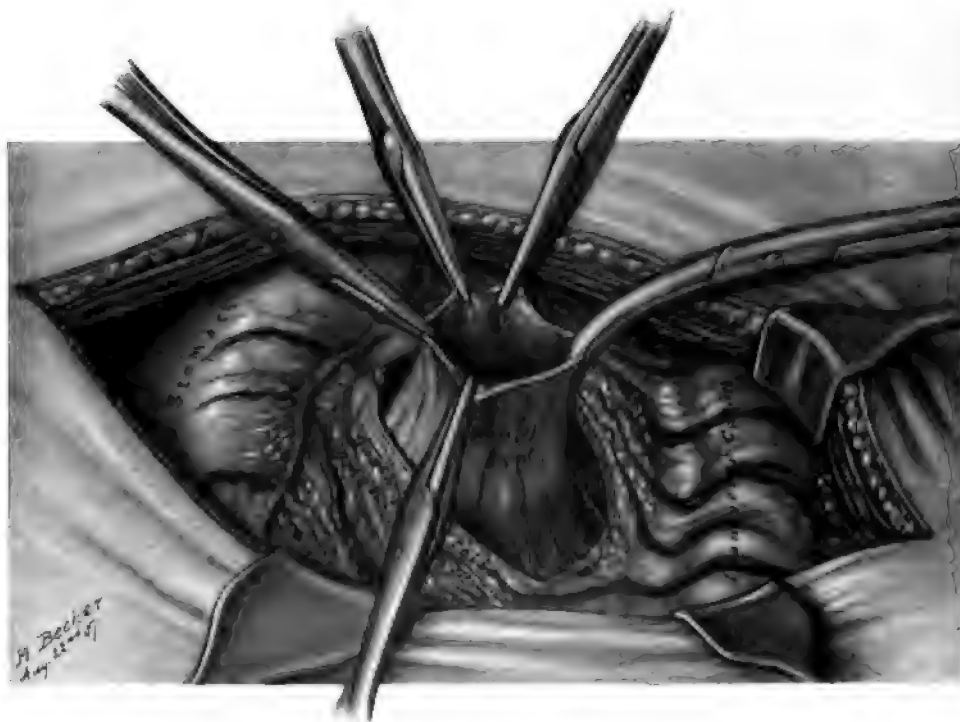


FIG. 775.—CYST OF PANCREAS WHICH HAS BEEN EMPTIED. ABDOMINAL PACKING REMOVED. (Author's case.)

The *pancreatotomy mesocolica* is used when the cyst presents below the transverse colon, having pushed the transverse mesocolon downward and forward. The mesocolon should be divided carefully to avoid injuring important vessels.

After opening a cyst its interior should be examined with the fingers and a sound to determine the presence of tumors, calculi, other cysts, etc. The cyst can be drained by means of gauze or rubber tubing. The author prefers the latter method, the tube being surrounded by a layer of gauze.

The amount of secretion following the drainage of a pancreatic cyst varies greatly. In Cushing's case¹ it amounted to 500 to 600 c.c. in twenty-four hours.

¹ Cushing, H. W.: "Traumatic Rupture of the Pancreas," etc., Boston Med. and Surg. Jour., 1898, cxxxviii, 429.

As a rule, the amount decreases rapidly, the cavity contracts, and generally in from four to six weeks only a small fistula with a moderate amount of discharge remains. This fistula may, however, last a long time and cause serious inconvenience. (See Pancreatic Fistulæ.) Pancreatic ferments may appear in the secretion a few days or weeks after the operation, though they may not have been present in the contents of the cyst. In a good number of cases polyuria and diabetes have been observed after the operation. The glycosuria may be the result of extensive injury to the gland or due to the progress of pancreatic disease which existed before the operation.

The healing process in cysts which have been opened and drained takes place in the following manner: After being emptied, the walls of the cyst collapse, granulate, and grow together. Since only those which are not covered with epithelium can granulate, the pseudo-cysts heal much more rapidly than the true cysts, which can only heal after their epithelial lining has been cast off.

In 1904 Robson¹ collected 160 cases of pancreatic cyst which had been operated upon. Of these, 140 recovered and 20 died as the result of the operation. In 138 incision and drainage was performed, with 16 deaths, equal to a mortality of 11.6 per cent. In 15 excision was performed, with 3 deaths, equal to a mortality of 20 per cent. Robson says: "These figures are clearly in favor of incision and drainage, but the mortality should be reduced by one-half."

Solid Tumors of the Pancreas.—In the present state of development of surgery, when almost all the regions of the body are accessible to the surgeon's knife, the solid tumors of the pancreas are acquiring new interest, but thus far the results of operative interference are not altogether encouraging.

Among the benign tumors of the pancreas we find tuberculoma, syphiloma, and adenoma.

Tuberculosis and syphilis of the pancreas do not present a great deal of surgical interest. Primary tuberculosis of this organ is undoubtedly rare. Many of the cases of tuberculosis of the pancreas doubtless begin as a tuberculosis of neighboring lymph-nodes, which later invades the pancreas. It may occur in the form of gummatous nodules or as a diffuse interstitial proliferation. In the case of Sendler² the movable tumor in the pancreas proved to be a tuberculous lymph-gland which was shelled out without difficulty and the patient recovered.

Like tuberculosis, syphilis produces two kinds of lesions in the pancreas, the chronic interstitial and the gummatous; the former, which is often found in congenital syphilis, is much more frequent, but the two varieties may coexist. I have found no cases on record in which syphilomata have been subjected to operation.

Adenomata of the pancreas have been rarely found and their occurrence has been doubted. Nicholls³ has described a typical case of adenoma of the pancreas,

¹ Robson, A. W. Mayo: "The Pathology and Surgery of Certain Diseases of the Pancreas," *Lancet*, 1904, i, p. 773.

² Sendler, Paul: "Zur Pathologie und Chirurgie des Pankreas," *Deutsche Zeitschr. f. Chir.*, 1896, xlv, S. 329.

³ Nicholls, Albert Geo.: "Simple Adenoma of the Pancreas arising from an Island of Langerhans," *Jour. Med. Research*, 1902, iii, p. 385.

exposed portion was at some distance from the anterior abdominal wall and could, therefore, not be sutured. The general cavity was walled off, the gastrocolic omentum was divided, and the greater part of the cyst removed by means of a large aspirating syringe; the cyst was then closed, the edges grasped with forceps (Fig. 775), and the remaining fluid squeezed out with sponges. A large rubber drainage-tube covered with gauze was inserted into the opening by means of a purse-string suture of catgut and the abdomen closed up to the drain. The patient made an uneventful recovery.



FIG. 775. CYST OF PANCREAS WHICH HAS BEEN EXPOSED.

The *pancreatotomy mesocolica* is performed by opening the transverse colon, having pushed the transverse mesocolon should be divided carefully.

After opening a cyst its interior can be drained by means of gauze sponges. If the cyst is large, the method, the tube being surrounded by gauze.

The amount of secretion of the pancreas is greatly increased. In Cushing's case¹

¹ Cushing, H. W.: "Trauma," *Ann. Surg.*, 1898, cxxxviii, 129.

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stomach; the patient recov
Piloni extirpated almost
covered, although only a s
In 1898 Codivilla,⁶ in a
case had involved the duodenum
the stomach, and the head of the
pancreas. After gastro-enterostomy and gastro-enterostomy
operation, of cachexia. Franke,⁷ in
removing a portion of the gland, the pa
tient recovered. "La chirurgia del pancreas," Clinica (Chirurgica)
di Bologna, 1902, p. 100.
"Die Bauchorgane," Deutsche Zeitschr. f. Chirurgie, 1902, i, p. 386.
"St. Louis Med. and Surg. Jour.," 1902, lxxviii, 100.
"Beiträge zur Chirurgie des Pankreas," Arch. f. klin. u. exp. Med., 1902, lxxviii, 100.
"Tumour from the Tail of the Pancreas," *Lancet*, 1902, i, p. 386.
"Pancreas," *Ann. Surg.*, 1902, lxxviii, 100.
"Die krebigen Bauchspeicheldrüse," Arch. f. klin. u. exp. Med., 1902, lxxviii, 100.

found at autopsy, and collected four others from the literature. There is little likelihood of an accurate diagnosis of such a tumor being made before operation. Biondi¹ successfully removed a fibroadenoma which involved two-thirds of the head of the pancreas. The patient was well one and a half years after the operation.

Primary sarcoma of the pancreas is quite rare and, like carcinoma, is seldom diagnosed early enough for successful surgical treatment. There are, however, several cases on record in which primary sarcomata of this organ have been removed and the patients recovered.

Trendelenburg² removed a spindle-cell sarcoma, the size of a man's head, originating in the tail of the pancreas. Recovery followed. Briggs³ successfully removed a spindle-cell sarcoma from the tail of the pancreas, the growth apparently originating in the wall of a hydatid cyst. Krönlein⁴ removed a tumor, the size of one's fist, from the head of the pancreas, the removal being very difficult. Death resulted from gangrene of the transverse colon due to interference with its circulation. Microscopic examination showed the tumor to be an angiosarcoma. Malcolm⁵ extirpated a fibrosarcoma of the tail of the pancreas, but death resulted from shock.

Carcinoma is by far the most frequent new-growth in the pancreas, and in over one-half of the cases involves the head of the gland; according to Oser, in 65 to 70 per cent.

Besides numerous cases in which portions of the pancreas, involved in cancer, have been removed along with the primary growth in the stomach, there are a good many cases recorded in which primary carcinomata of the pancreas have been removed with more or less of the gland. Such cases have been reported by Ruggi, Terrier, Tricomi, Codivilla, Franke and others. Ruggi removed through the loin an adenocarcinoma of the pancreas weighing 660 grams; the patient recovered from the operation, but died some months later. Tricomi extirpated almost the entire pancreas for adenocarcinoma; the patient recovered, although only a small portion of the tail of the pancreas was left behind. In 1898 Codivilla,⁶ in a case of carcinoma of the head of the pancreas which had involved the duodenum and stomach, resected the duodenum, a part of the stomach, and the head of the pancreas, completing the operation by a cholecystenterostomy and gastro-enterostomy; the patient died twenty-four days after the operation, of cachexia. Franke,⁷ in two cases of carcinoma of the pancreas, extirpated a portion of the gland, the patients

¹ Biondi, D.: "Contributo clinico e sperimentale alla chirurgia del pancreas," *Clinica Chirurgica*, 1896, iv, 131.

² Witzel, Oscar: "Beiträge zur Chirurgie der Bauchorgane," *Deutsche Zeitschr. f. Chir.*, 1886, Bd. xxiv, S. 326.

³ Briggs, Waldo: "Tumor of the Pancreas," etc., *St. Louis Med. and Surg. Jour.*, 1890, lviii, p. 154.

⁴ Krönlein: "Klinische und topographisch-anatomische Beiträge zur Chirurgie des Pankreas," *Beiträge z. klin. Chir.*, 1895, Bd. xiv, S. 663.

⁵ Malcolm, John D.: "Removal of a Sarcomatous Tumour from the Tail of the Pancreas of a Child Four Years and Eight Months Old," *Lancet*, 1902, i, p. 586.

⁶ Villar, Francis: "Chirurgie du Pancréas," Paris, 1906.

⁷ Franke, Felix: "Ueber die Exstirpation der krebsigen Bauchspeicheldrüse," *Arch. f. klin. Chir.*, 1901, Bd. xlv, S. 364.

dying fifteen and seventeen days respectively after the operation, one of secondary hemorrhage, the other of infection. In another case he extirpated the entire carcinomatous pancreas; this patient recovered from the operation, but died five months later of recurrence; there was only a slight glycosuria, which lasted from the fifth to the eighteenth day, and there were no fatty stools.

On the strength of this case Franke thinks the results of the animal experiments of Minkowski and von Mering are probably not applicable to man, and that in the case of the latter, total extirpation of the pancreas is not necessarily fatal, the functions of the pancreas sometimes being taken up by an accessory pancreas or else compensated for by some other physiologic process.

As a rule, solid tumors of the pancreas are not diagnosed until symptoms (jaundice, ascites, etc.) are present which indicate involvement of important structures, hence the results of operative interference, up to the present time, have been far from satisfactory. We should, therefore, strive to make an earlier diagnosis and operate earlier. The clinical symptoms are at first obscure, and an early diagnosis is extremely difficult. Franke thinks the following are the symptoms which might aid in an early diagnosis: the "characteristic" epigastric pain, the rapidly progressing cachexia, and the demonstration of a tumor. These symptoms might lead to a probable diagnosis and warrant exploration.

In 1906 Villar (*loc. cit.*) collected fifteen cases in which the pancreas had been partially resected for solid tumors; of these, seven recovered from the operation and eight died.

The anterior abdominal incision will usually be used for solid tumors of the pancreas, but when the tumor arises from the tail of the gland and extends out into the left flank, the incision may be made in this region. As in the case of cysts, the further exposure of the growth, *i. e.*, through the gastrohepatic or gastrocolic omentum or the transverse mesocolon, will depend upon its position relative to the stomach or transverse colon. After exposing the tumor we must determine whether an attempt should be made to remove it. If it is encapsulated, it can probably be removed without great difficulty. If it involves only the tail or a portion of the body of the pancreas and is not too intimately adherent to the surrounding structures, it can perhaps be removed with the involved portion of the gland. If there is a diffuse involvement of the organ, including its head, removal will be extremely difficult, and in most cases inadvisable.

The tumors most suitable for extirpation are those which originate in the tail of the gland and are connected with the rest of the gland by a kind of pedicle which it is only necessary to ligate and divide. As a rule, it is safer to place a gauze tampon against exposed pancreatic tissue. In operations involving the head of the pancreas, the common duct, vena cava, portal vein, and superior mesenteric vessels should be carefully avoided. In Krönlein's case injury to branches of the latter was followed by gangrene of the colon.

In most of the cases of malignant growths of the pancreas which we see, radical operations are inadvisable and we sometimes resort to palliative measures. Chole-

cystostomy and cholecystenterostomy for the relief of the jaundice are, however, attended by a high mortality and, when successful, prolong the life of the patient so little that these operations should seldom be done unless the jaundice (itching, etc.) is very annoying to the patient. The chief argument in their favor is that chronic pancreatitis, which can sometimes hardly be distinguished from cancer of the pancreas, is greatly benefited by these procedures. Death following them is often the result of post-operative hemorrhage due to the jaundice.

The following are the statistics of Mayo Robson: Of fifteen cases in which he performed cholecystostomy for carcinoma of the pancreas with jaundice, eight recovered from the operation, the longest survival being eight months, but the average survival was about four months; of the six cholecystenterostomies, two recovered and the duration of life was only a few weeks; of six exploratory laparotomies, two died.

In a few rare instances the growth in the head of the pancreas has so constricted the duodenum that it has been considered advisable to perform a gastro-enterostomy.

Pancreatic Fistulæ.—Fistulæ which result from the drainage of wounds or cysts of the pancreas are very annoying, owing to their persistence and to the excoriation of the skin produced by the pancreatic secretion. Many cases are on record in which they have lasted a year or more and some have even been permanent.

The excoriation of the skin is often distressing in spite of everything that is done to combat it, such as the application of various ointments, lanolin, etc. Burmeister¹ has applied suction-pump drainage to such fistulæ and claims to have obtained excellent results, the skin being thus kept dry and intact and the healing of the fistula hastened. This method is also recommended by Heineke.² The best way to hasten healing, however, is by the administration of a carbohydrate-free diet, as advised by Wohlgemuth,³ who has shown that the amount of pancreatic secretion depends upon the composition of the diet: with purely fatty diet the secretion is minimal, with proteid diet somewhat more, and with carbohydrate diet is considerably increased. Acids stimulate and alkalies retard the secretion. For such cases Wohlgemuth recommends a carbohydrate-free diet with frequent small doses of sodium bicarbonate.

In a case of Karewski⁴ the fistula was thus quickly cured, and Heineke reports a case in which the fistula closed three days after the treatment was instituted.

Sometimes curettage or cauterization of a pancreatic fistula will cause it to heal. These methods are, however, not totally devoid of danger, as cases of fatal hemorrhage have been known to follow their use. If the sinus persists after all of the above mentioned expedients have been tried, it may be advisable to excise it or institute posterior drainage.

¹ Burmeister, R.: "Ueber Saugpumpendrainage bei Pankreascyste," Arch. f. klin. Chir., Bd. lvi, S. 183.

² Heineke, H.: "Zur Behandlung der Pankreasfisteln," Centralbl. f. Chir., 1907, Bd. xxxiv, S. 265.

³ Wohlgemuth, J.: "Untersuchungen über das Pankreas des Menschen," Berl. klin. Wochenschr., 1907, xlv, Nr. 2, S. 47.

⁴ Karewski, F.: "Ueber isolierte subkutane Verletzungen des Pankreas und deren Behandlung," Berl. klin. Wochenschr., 1907, xlv, Nr. 7, S. 187.

CHAPTER XXXVII.

OPERATIONS UPON THE SPLEEN.

BY HOWARD A. KELLY, M.D.

Although the spleen is not often the subject of operation in the practice of any one surgeon, the total number of operations upon this organ has been considerable. The variety of indications for splenic operations, of a more or less radical nature, must surprise any one who investigates the subject carefully for the first time. They have been done for the following conditions: (1) Displaced or wandering spleen; (2) torsion of pedicle; (3) simple hypertrophy; (4) malarial hypertrophy; (5) splenomegaly with anemia, or associated with cirrhosis of liver and ascites, called Banti's disease; (6) chronic enlargement in infancy; (7) traumata, such as stab wound, gunshot wound, laceration from contusion; (8) blood cyst; (9) simple cyst; (10) echinococcus cyst; (11) abscess; (12) tuberculosis; (13) sarcoma; (14) syphilis; (15) amyloid degeneration; (16) angioma; (17) leukemia.

Let me say emphatically at the outset that it is now universally agreed, after numerous distressing failures following the attempts of enterprising surgeons, that leukemia should never be treated by splenectomy. Such patients, if operated upon, almost always die immediately, and of the few which have survived the operation, not one has been cured of the disease.

Sometimes the conditions to which reference has been made appear in combination. Sutton, in 1898, described a wandering tubercular spleen, and numerous cases of displaced hypertrophied spleens are on record.

Many cases of hypertrophy of the spleen associated with twisted pedicle have also been recorded. J. C. Webster¹ describes one of the most interesting of these, in which the spleen weighed 28 ounces.

Traumatic injuries to the spleen, such as laceration, gunshot wound, etc., are most frequently associated with other and, as a rule, far graver injuries to the abdominal viscera. The spleen may even in such cases escape through the wound and remain for a long time outside the abdominal cavity. This actually occurred in one extraordinary Indian case, where the patient traveled about for weeks with a fungating mass protruding under the left ribs. Other complications arise from the combination of a splenic affection with disease of some other organ, as, for example, ovarian cyst with displaced spleen. Such a case was recorded by Péan² in 1869.

Almost all important references to the literature of the spleen are to be found in an admirable historical review by B. M. Ricketts, of Cincinnati, entitled "Surgery

¹ Webster, J. C.: "A Case of Successful Removal of an Enlarged Spleen," *Jour. Amer. Med. Assoc.*, 1903, xl, 887.

² Péan, J.: "Ovariectomie et splénectomie," Paris, 1869.

Contraindications to Operation.—Among the contraindications to operations upon the spleen, Laurent¹ cites the following grave conditions in other organs: Multiple hydatid cysts; amyloid degenerations; leukemia; pseudo-leukemic hypertrophy; general complications: tuberculosis, syphilis, cardiopathy, pneumonopathy; tumefaction secondary to cirrhosis of the liver; splenic metastases, pyemia, or malignant disease. In cachexia, with grave anemia, general edema, marked tendency to hemorrhage, and extensive adhesions, the ablation of a hypertrophied malarial spleen is contraindicated.

Contraindications to operation are also found in the secondary splenic tumors, arising, for example, when enlargement of the spleen follows cirrhosis of the liver; in cases of amyloid degeneration or tuberculosis elsewhere; in syphilis; and where there is portal obstruction.

A pulsating splenic tumor is not a suitable object for a radical operation, as this disease is usually associated either with acute infectious diseases or hypertrophy of the left ventricle, and especially with aortic insufficiency.

In children there is a form of anemia associated with splenic tumor which Morse² calls "secondary anemia with splenic tumor." In an interesting case of a baby in Morse's hands, the child had rickets and enlarged spleen with anemia. A nutritive diet of milk and beef-juice, together with maltine, oil, and syrup of the iodid of iron, soon brought about remarkable improvement, and reduced the size of the spleen, which extended to the right of the umbilicus, so far as the anterior superior spine, and back into the loin, to such a marked degree that it could not be felt.



FIG. 776.—MORSE'S CASE OF INFANTILE HYPERTROPHY OF THE SPLEEN WITH ANEMIA CURED BY MEDICINAL HYGIENIC TREATMENT.

A, Spleen; B, lower border of liver; C, costal border.

This is a condition which has often been spoken of as "anemia infantum," or "anemia infantum pseudo-leukemia." I mention this condition thus carefully as a warning to the surgeon. (See Fig. 776.)

Diagnosis.—With the exception of simple excessive mobility and traumata of the spleen, all the conditions indicating operation are associated with more or less

¹ Laurent, O.: "Anatomie Clinique et Technique Operatoire," Paris, 1906, p. 629.

² Morse, J. L.: "Chronic Enlargement of the Spleen in Infancy." *Ann. Gyn. and Ped.*, 1900, xiv, 153.

hypertrophy of the organ. The movable spleen is best recognized by a peculiar softness, a distinctive notch, and a wide range of mobility, associated with the absence of the normal dullness on percussion in the left lower chest, and it is most apt to be mistaken for a movable left kidney or an ovarian tumor. The distinction between spleen and kidney is easily made by introducing a renal catheter and injecting the kidney with enough fluid to produce a mild renal colic, which will be referred to the lumbar region and not to the organ under touch beneath the abdominal wall. A normal pregnancy has been mistaken for a hypertrophied movable spleen in my own clinic, though fortunately no operation was done.

Careful pelvic examination under an anesthetic ought to exclude uterus, tubes, and ovaries from participation in the disease, while the skiagraph and the renal catheter should distinguish renal tumors, thus leading up to the spleen by a simple process of exclusion. In the above consideration the spleen alone has been considered in association with its abnormality. When, however, the affected spleen is associated with a blood disease, as malaria or leukemia, a blood examination both suggests and confirms diagnosis.

In trauma the diagnosis may be made when the injury is in the splenic region, particularly when the spleen is enlarged. As a rule, however, the signs are merely those of internal hemorrhage and collapse, and it is not possible to predicate just what organ or organs are involved, whereas in splenomegaly the diagnosis is not so difficult, as

the characteristic form and notch are retained. Great difficulty, however, may arise when the enlarged organ becomes fixed at a point remote from its normal habitat.

It is well that the surgeon should be on his guard and not confuse certain rare cases of hyperglobulia and splenic tumor with other diseases, but this peculiar disease shows a combination of the following symptoms: cyanosis, tachycardia, dyspnea, albuminuria, sometimes enlargement of the liver, and enlargement of the spleen, together with an increase in the number of red blood-cells, called by Wm. Osler¹ "chronic polycythemia with cyanosis and enlarged spleen"; see also P. Preiss.²

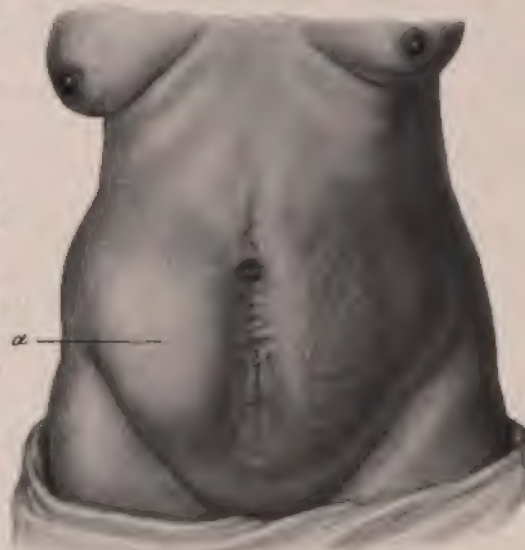


FIG. 777.—SPLENIC TUMOR (a) IN THE RIGHT ILIAC FOSSA. Removed by J. C. Webster. b, Site of incision four years previously.

¹Osler, W.: "Prin. and Prac. Med.," 1905, p. 762.

²Preiss, P.: "Hyperglobulie und Milztumor," Mitth. a. d. Grenz. der Med. u. Chir., 1904, xiii, 287.

Not infrequently the operation upon the spleen is wholly unpremeditated, the diagnosis beforehand having been that of a fibroid tumor of the uterus, an ovarian tumor, or perhaps a misplaced kidney. In one of my own splenectomies the movable pelvic tumor was supposed to be ovarian until the abdomen was opened. In J. C. Webster's case (see Fig. 777) the prominence caused by the enlarged spleen lay in the iliac fossa, and the clinical symptoms strongly suggested an intermittent hydronephrosis; indeed, the abdomen had already been incised four years before, and the surgeon at that time declared that he found an inoperable right renal tumor.

Bland-Sutton,¹ in a thoughtful article on wandering spleen, cites a case, showing occasional difficulties in diagnosis. A girl, fourteen years of age, had a tumor floating in the intestines, where it lay obliquely across the left side of the abdomen, its upper end reaching the left hypochondrium. Nothing abnormal was felt on pelvic examination, and the splenic area was resonant. The tumor had the shape and notched border of a spleen, leading to a diagnosis of wandering spleen; therefore an incision was made in the left semilunar line to remove it, when a multilocular ovarian cyst was found, partly collapsed from a rupture of its largest loculus. The secondary cyst gave rise to the sensation of splenic notches.

Körte, cited by Bland-Sutton, had a case of wandering spleen which he regarded as a wandering kidney, and when signs of internal strangulation arose, he punctured the tumor; nothing but blood escaped, however, and the patient died with signs of intestinal obstruction and peritonitis. A post mortem then disclosed the spleen lodged in the pelvis and obstructing a loop of intestine.

Splenectomy is the typical operation, inasmuch as the spleen can readily be removed, the economy suffering no detriment from its loss; while, on the other hand, conservative operations involving a resection, or a suture either for injuries or for the purpose of suspension, are all, as a rule, more troublesome and more dangerous than total extirpation. I would not, however, utterly reject all conservative methods, as they are proper from time to time in peculiarly suitable cases.

SPLENECTOMY.

Technic.—The general principles of splenectomy are: first, the *incision*, which may be made along the border of the ribs, or as a median laparotomy in cases of hypertrophied spleen, or of exploration for abdominal trauma. A convenient incision may also be made in the left semilunar line, over the most prominent part of the spleen. If the opening secured in this way is not large enough, it can be made much larger by carrying a horizontal incision from the vertical one down into the left flank. On the whole, the semilunar incision is to be preferred.

The next step, with a movable spleen, is to bring it outside the body and protect the adjacent intestines, while exposing its pedicle for ligation. If the spleen is adherent, the adhesions should first be separated, if they are not too vascular, and the organ should then be delivered from the abdomen. In case of adherent spleen in

¹ Bland-Sutton, J.: "Remarks on Wandering Spleens," Brit. Med. Jour., 1897, 132.

which the pedicle is accessible, the vessels may first be doubly tied and then cut between the ligatures, the adhesions being easily dealt with. When these adhesions are numerous and excessively vascular, it will often be wise to desist from proceeding with the operation, for death from uncontrollable hemorrhage can easily occur.

The splenic vessels can often be best exposed, in the case of an enlarged spleen still within the abdomen, by rotating the organ outward and at the same time drawing the stomach inward.

Ligation of the Pedicle.—Where there is a non-vascular fold of peritoneum above the vessel, it may be cut through; when the artery stands out prominently, it must first of all be ligated. In general, the first plan is to ligate the pedicle by a series of

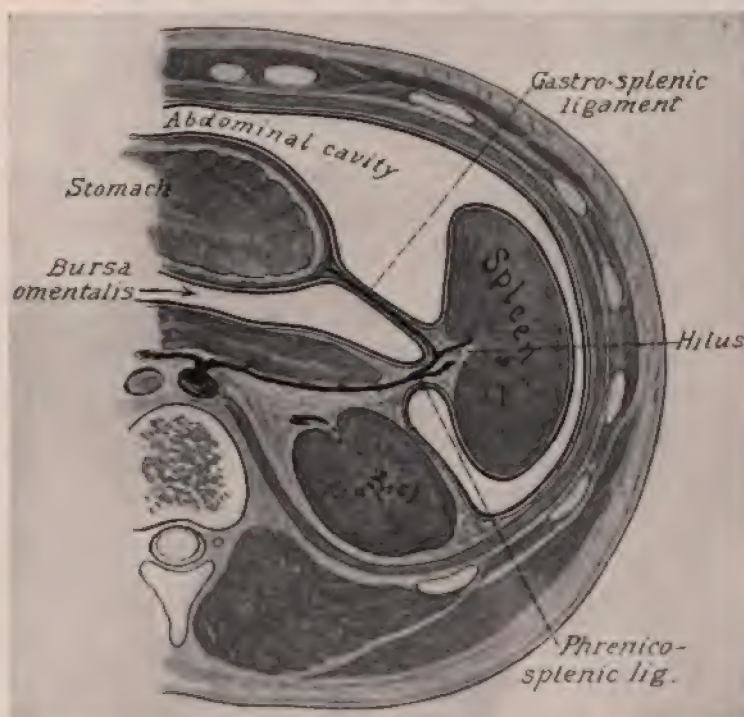


FIG. 778. — HORIZONTAL SECTION THROUGH SPLENIC REGION VIEWED FROM BELOW.
The stomach is drawn to the right in order to stretch the gastrosplenic ligament.

interlocking silk ligatures, passing them as far away from the spleen as possible so as to avoid any risk of their slipping after the removal of the organ. After applying the ligatures, the vessels may be controlled on the side of the spleen by strong artery forceps, after which they are divided at a good safe distance from the ligatures, and the organ removed.

As a next step a careful examination of the pedicle should be made to make sure that hemorrhage is impossible. If there is any doubt of the thoroughness of the ligation or the security of the ligatures, it is a safer plan to pick up the ends of the vessels individually and to tie them with strong catgut.

Examination of the pedicle of the spleen is always necessary before ligation, as the tail of the pancreas is often drawn out so as to form a part of it. Engel has proposed twisting the pedicle in the abdomen so as to bring about an atrophy, which is a suggestion hardly likely to find favor in these days.



FIG. 10. SPLENECTOMY.

The illustration shows the enlarged vasa brevia between the spleen and the stomach, and the dotted line indicates the incision line for the ligaments.

Post-operative Sequelæ. The commonest sequel to splenectomy is, fortunately, a rapid recovery without any discernible change in the blood. The liver becomes a building place for both red and white blood-

Examination of the pedicle of the spleen is always necessary before ligation, as the tail of the pancreas is often drawn out so as to form a part of it. Engel has proposed twisting the pedicle in the abdomen so as to bring about an atrophy, which is a suggestion hardly likely to find favor in these days.



FIG. 779. — SPLENECTOMY.

First step in a splenectomy which may necessitate tying the enlarged vasa brevia between the spleen and the stomach. The vessels may be tied and gastrosplenic ligaments incised as shown in the dotted line,

Post-operative Sequelæ.—The commonest sequel to splenectomy is, fortunately, an uninterrupted convalescence without any discernible change in the patient.

The spleen has been described as a building place for both red and white blood-

cells and also as the normal place for destruction of red blood-cells, but whatever may be the physiology, its function or functions are easily assumed by other organs. Animal experiments seem to point to the bone-marrow and lymph-glands as vicars for the spleen, and in splenectomized animals, hyperemias of the bone-marrow have

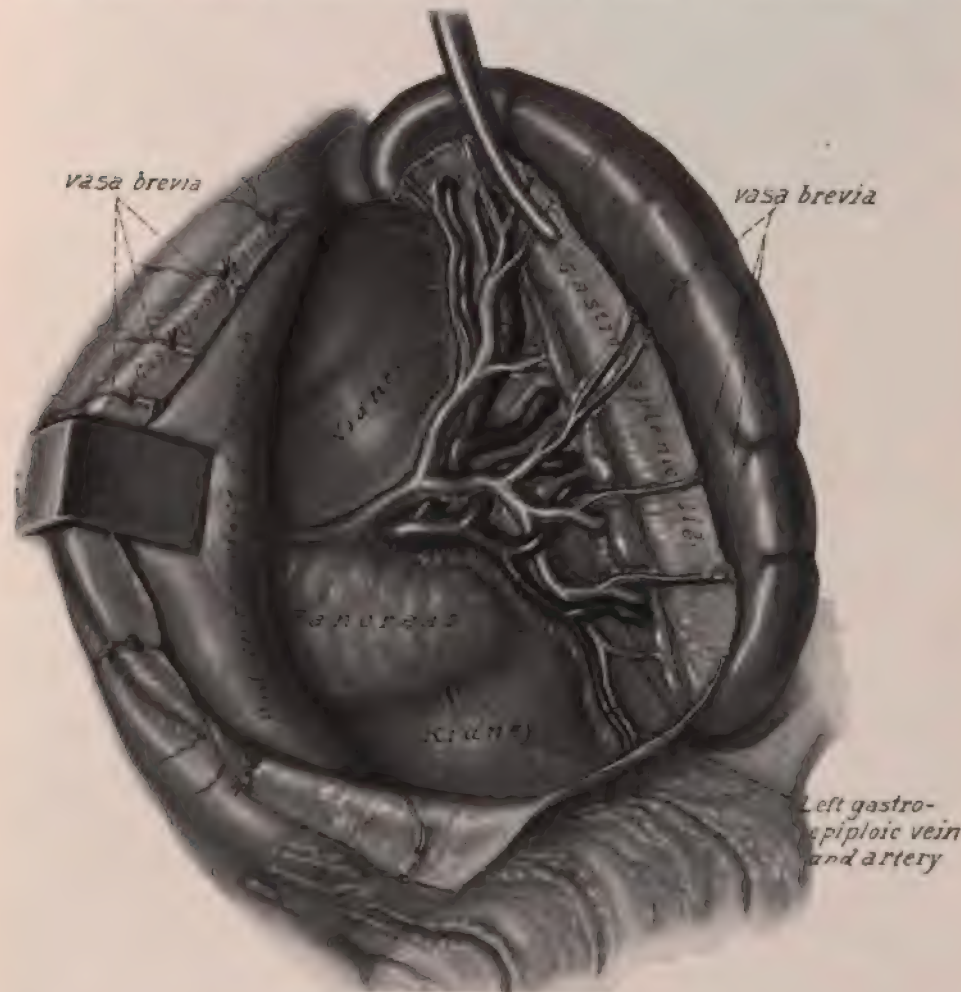


FIG. 780.—SPLENECTOMY.

After severing the gastrosplenic ligament the large splenic vessels are exposed. The pedicle is formed and exposed for ligation by lifting the spleen well out of its bed and out of the abdomen. One ought to avoid the left gastro-epiploic vein and artery if possible.

been observed. Hartley¹ has described in three cases a transitory hypertrophy of the thyroid.

It has been frequently observed and reported that a general enlargement of the lymphatics takes place after splenectomy, while the cervical glands and the tonsils seem to be affected most frequently. Irregular rises in temperature have been

¹ Hartley: "Splenectomy," *Med. News*, 1898, lxxii, 417.

reported by Bond and others, and in a number of cases infection of the pedicle has occurred, leading to severe pain in the left hypochondrium as late as two weeks after operation. This, again, has been followed by a localized accumulation of pus discharged through the abdominal wall or into the bowel, and in one instance the pedicle ligatures themselves were coughed up by the patient. Changes in the blood are decidedly inconstant, and in many cases would seem to depend on other conditions than the spleen's removal. The commonest change observed has been a decrease in the number of red blood-cells and an increase in the number of the white, this change lasting, on an average, about two months. It seems to occur fairly constantly in dogs. Bond,¹ in two cases, observed a great increase in the number of red blood-cells, which he explained by a decreased destruction of them.

In two of my own cases of enlarged movable spleen, where careful blood studies were made before and after operation, no abnormal constituents were found in the blood, the relative proportion of the white cells being uninfluenced by removal of the spleen; and in neither case was any diminution of the red cells noted, though in one there was a slight increase in the number of white blood-cells, which disappeared within a month.

The tabulated list at the beginning of the chapter shows in what conditions splenectomies have been done; the long list of such conditions and the considerable number of positive contraindications to operation which have been adduced from them suggest at once both the difficulty and the importance of an accurate differential diagnosis. No operator should remove a spleen without a previous general and searching examination; while a knowledge of the blood findings is especially imperative. An extensive consideration of these conditions is manifestly impossible here, where a bare pointing out of certain salient features and an exhibition of operative indications and results is all that can be indicated. The reader, however, is urged to consult standard medical works for further information. Unless the differential diagnosis and clinical courses of the various splenomegalies are understood and constantly kept in mind, surgery is a hazardous procedure, as a radical operation may easily be productive of great harm.

In considering the separate subjects, the order adopted in the table at the beginning of the chapter will be adhered to.

DISPLACED OR WANDERING SPLEEN, WITH OR WITHOUT TORSION OF THE PEDICLE.

Neither a fixed displacement nor an abnormal mobility of the spleen are conditions of common occurrence, and no one observer has reported any considerable series of cases. Nevertheless, there are few surgeons of large experience who have not met with and treated one or more, so that the total number reported is larger than would be supposed.

Fixed ectopia is secondary to changes which serve to anchor an abnormally

¹ Bond, C. J.: "Remarks on a Case of Splenectomy, with Observations on the Condition of the Blood before and after Operation," *Lancet*, 1896, i, 1207.

mobile spleen in its abnormal situation, and for this reason it is best regarded as a complication of wandering spleen. Such a condition is never congenital.

Normally, the spleen is not a freely movable organ, this fact rendering all the more striking by contrast the extreme mobility which it may acquire in these cases, for there is scarcely a region of the abdomen where it has not been found. Even the true pelvis seems to be a common site. In one of my own cases at the Johns Hopkins Hospital (Gyn. No. 7193) it was firmly wedged in the true pelvis, and was mistaken for a large myoma springing from the posterior wall of the uterus. In another case (Gyn. No. 9737) it was twisted and became fixed in the region of the cecum, occasioning symptoms of an ectopic right kidney.

The unusual enlargement which most of these spleens show may be due to a true hypertrophy, but is most frequently dependent on venous engorgement. The following case (Bland-Sutton¹) well illustrates how greatly simple engorgement influences the size of this organ:

"In a young girl, laparotomy disclosed an enormous spleen, reaching all the way from the diaphragm to the top of the uterus. On delivering this organ and surrounding it with cool gauzes, Sutton saw it contract to one-third of its size when first exposed."

The commonest complication of a wandering spleen is a twisted pedicle. The ease with which a twist may take place is readily comprehended, as also are its results. When the rotation occurs gradually, an atrophy of the organ may follow; on the other hand, if the circulation is cut off at once, gangrene takes place. After twisting, perisplenitis is constantly found and the organ almost always becomes adherent. Owing to its poor circulation abscess may develop, as in a case in the hands of my colleague, W. S. Halsted, which is reported by Osler.² Among other complications of mobile spleen, tuberculosis has been noted; Llobet³ reports the occurrence of a cancer of the pedicle. The cause of the mobility is not clear; many of the ingenious explanations offered for movable kidney have been advanced here. It is more frequent in women than in men; the spleen is enlarged; and the patients are usually thin; these are the known factors.

It has been noted that movable spleen may cause few or no symptoms; a majority of cases, however, complain of the discomfort arising from the vagrant organ and suffer from marked digestive disturbances, the commonest site of the pain being in the left epigastric region, and its nature a chronic ache, but neither location nor character is constant. In the case already referred to (Gyn. No. 7193), the patient had what at first sight appeared to be a left renal colic. The pain began in the renal region, and radiated down the course of the ureter.

Kouwer⁴ attributed a complete uterine prolapsus to pressure from a misplaced spleen above the womb, and several cases of intermittent attacks of jaundice have been found due to a splenoptosis.

¹ Loc. cit.

² Osler, W.: "Prin. and Prac. of Med.," sixth ed., 1905.

³ Llobet, A. F.: "Splénectomie totale." *Rev. de chir.*, 1900, xxi, 222.

⁴ Kouwer: "Behandeling der wandelnde milt door splenoptosis," *Nederl. Tijdschrift v. Geneeskunde*, 1895, xxxi, 669.

Acute twisting of the pedicle presents a clinical picture like that familiar in the twisting of the pedicle of an ovarian cyst; great pain, abdominal tenderness, rigidity, fever, and leukocytosis are present. The shock may, in some cases, be intense, and Richard Douglas¹ reports an instance of death occurring within six hours after the first symptoms. Unless the spleen has been known to be movable, the diagnosis before celiotomy in such a case may be impossible.

The diagnosis that the particular organ in distress is the spleen must rest on a careful exclusion of other abdominal organs and tumors, especially the ovaries and left kidney, also the detection of the characteristic notch and form of the spleen. It is a fact to be noted that the absence of splenic dullness is often misleading, though its presence in its normal site is of greater value. A movable spleen may occasion great distress. Its particular dangers are rupture of the stomach or duodenum, intestinal obstruction, rupture of the spleen, and twisting of its pedicle. If the symptoms are slight, treatment may be limited to a well-fitting bandage. I have found, however, that this rarely gives relief when the discomfort is excessive, and in such cases a radical operation is indicated.

Splenectomy is a safer and a surer expedient than those procedures which are designed to produce fixation of the spleen at or near its normal habitat. Splenopexy is absolutely contraindicated when the spleen is diseased. The four cases on which I have had occasion to operate all had a history of malaria. Stierlin² found malarial hypertrophy in thirteen out of twenty-eight cases which he collected out of the literature; and thirty-two splenectomies for wandering spleen, with only two deaths, these occurring as early as 1874 and 1878. My own four splenectomies, I found, did well after operation, and all have remained well and free from discomfort.

Splenopexy has been successfully performed by several methods, though I deprecate the use of sutures passed directly through the tissues of the organ, as the spleen shows a great tendency to break loose, and severe hemorrhage occasionally takes place. Basil Hall³ describes an ingenious procedure in the case of a spleen with a very deep notch. He used the notch so as to pocket the organ in a peritoneal pouch, leaving only half of it projecting into the general peritoneal cavity; and my colleague, W. S. Halsted, in two cases, cited by Wm. Osler, successfully fixed the spleen by means of a temporary gauze packing, thus producing adhesions which held it well up; but in view of the simpler convalescence and surer results of splenectomy, such operations should, as a rule, not be employed.

SIMPLE HYPERTROPHY OF THE SPLEEN.

True hypertrophy of the spleen, independent of all known causes of splenic enlargement, and not associated with anemia, is occasionally seen. J. C. Warren⁴

¹ Douglas, R.: "Surgical Diseases of the Abdomen," 1903, p. 429.

² Stierlin, R.: "Ueber die chirurgische Behandlung der Wandermilz," *Deut. Ztschr. f. Chir.*, 1897, xlv, 382.

³ Hall, J. Basil: "Splenopexy for Wandering Spleen," *Ann. of Surg.*, 1903, xxxvii, 481.

⁴ Warren, J. C.: "The Surgery of the Spleen," *Ann. of Surg.*, 1901, xxxiii, 513.

states that it is common among the Armenians of Boston, and has no special clinical significance. The inhabitants of southern Italy seem also to be liable to this condition, which may persist for years without producing any deterioration of general health and give rise to no trouble. When it causes marked discomfort, which happens occasionally, the spleen should be removed. D'Arcy Powers¹ reports the successful removal of a large spleen of this kind from a woman forty-three years old.

MALARIAL HYPERTROPHY.

The ague-cake spleen, so common in some parts of the United States, as well as in all other regions where malaria holds sway, sometimes resists all drugs and hygienic treatment, and may occasion great discomfort, not to say danger, to its unhappy possessor. Whether there are good grounds or not for the theories of Jonnesco² and others, that the spleen affords both a harbor and breeding-place for the parasite of malaria, the fact that certain intractable malarial infections, associated with enlarged spleen, yield to splenectomy after resisting everything else, is beyond question.

The recognition of this form of hypertrophy rarely causes difficulty. The history of chronic malaria, if the actual demonstration of the plasmodium in the blood fails, makes the diagnosis easy and positive.

The principal indications for splenectomy, which is the only surgical procedure to be considered in this connection, are pain and disturbed function in other organs dragged or pressed upon by the enlarged spleen, which often becomes adherent to its surroundings. We must not forget that there is also a tendency on the part of such a spleen to rupture, either spontaneously or from some slight trauma. Osler notes the occurrence of this serious complication after a simple puncture for diagnostic purposes.

It has already been pointed out that enlarged spleen and failure to cope with an active malarial infection by medicinal means may be another reason for surgery. But it is to be constantly kept in mind that most hypertrophies due to malaria will yield to medicinal treatment, if sedulously employed, and that surgery is always a *dernier ressort*. Also that the medicinal treatment, unless the symptoms are urgent, must be carried on for months.

Vulpius,³ in 1884, collected 26 cases with 11 deaths. Nonnotti⁴ reports 9 personal cases with 3 deaths. The presence of adhesions is shown by the statistics of Vanwerts.⁵ This author found that of 35 uncomplicated splenectomies for malarial hypertrophy, only 2 died from the operation, whereas out of 39 extensively adherent cases, no less than 28 were lost. Hartley⁶ reports a case of a young man of twenty-

¹ Powers, D'Arcy: "Successful Removal of an Enlarged and Displaced Spleen," Brit. Med. Jour., 1900, ii, 1428.

² Jonnesco, T.: "Ueber Splenektomie," Arch. f. klin. Chir., 1897, lv, 330.

³ Loc. cit.

⁴ Nonnotti, A.: "Secondo contributo allo studio delle indicazioni della splenectomia nella splenomegalia malarica," Centralb. f. Chir., 1901, xxviii, 703, Abstract.

⁵ Vanwerts, J.: "De la splénectomie," Thèse de Paris, 1897.

⁶ Loc. cit.

four, who showed a marked improvement following operation, after quinin had proved entirely ineffectual.

Extensive adhesions, then, must be regarded as a most serious complication, if not an actual contraindication to operation. Among other contraindications are advanced age, excessive ascites, and a high degree of cachexia.

BANTI'S DISEASE.

Several closely related, if not identical, splenic affections present the common associated characteristics of anemia and splenomegaly. Banti's disease is the best known of the group, to which Gaucher's chronic endothelioma of the spleen, and Taylor and Brill's family splenomegaly belong.

The **etiology** of these affections is obscure, but radical operations have taught us that the primary seat of trouble lies in the spleen, and the pathologic changes found in the liver and other organs must be due to a toxin manufactured in the diseased organ.

The **symptoms** in the early stages of Banti's disease, in addition to anemia and enlargement of the spleen, consist of pigmentation of the skin, marked digestive disturbances, and a tendency to hemorrhage, especially gastric. Osler found this symptom in seven out of fifteen cases, and has especially urged its diagnostic importance. With the progress of the disease, the weakness and the anemia increase *pari passu*, cirrhosis of the liver develops along with ascites and with attacks of intermittent jaundice. The anemia belongs to the secondary type, that is to say, the color index of the individual red blood-cell is lower than normal. The actual number of red blood-cells, however, also decreases from the beginning of the disease, and in the last stages may fall as low as 1,500,000 per cubic millimeter.

*Gaucher's disease*¹ is characterized by a transformation of the splenic pulp into large epithelioid cells, while its clinical manifestations are very similar to those of Banti's disease, but it seems to progress more slowly.

Frederick Taylor, Brill, and Fournier have described a very slowly progressive form of Banti's disease, characterized by the fact that it makes its onset in childhood, and that it attacks several members of the same family.

The natural course of these diseases is progressive, and there is no evidence that any medicinal treatment can prevent the ultimate death of those attacked by them, though the results of early surgical interference offer more hope. Among the various reports Bessel Hagen gives sixteen cases of splenectomy for Banti's disease with three deaths and a number of complete and permanent recoveries. Harris and Herzog² report two personal cases and add seventeen others from the literature, with a total of four deaths. An interesting case, which shows that surgery may

¹Gaucher, P. C. E.: "De l'épithélioma primitif de la rate, hypertrophie idiopathique de la rate sans leucémie," Thèse de Paris, 1882.

²Harris, M. L., and Herzog, M.: "Splenectomy in Splenic Anemia or Primary Splenomegaly," Ann. Surg., 1901, xxxiv, 111.

benefit even in the last stages, is given by Tancini.¹ In addition to splenectomy, he did a Talma operation (attachment of scarified liver and omentum to the abdominal wall) in the case of a woman forty-six years of age. This patient, who at the time of operation was in a very weak condition and had a marked ascites, seemed perfectly well five months later. Finkelstein² reports a similar case, and Roger³ reports two others, which were successful. J. Collins Warren,⁴ of Boston, has collected twenty-five splenectomies for Gaucher's disease, with twenty recoveries.

Whenever a splenomegaly with a secondary anemia of unknown origin persists for some time, even without the skin pigmentation and later manifestations of Banti's disease, the indication is positive to perform splenectomy. Notwithstanding the advisability of operation as early as possible in the course of the disease, it may be done with every hope of success even in its later stages.

CHRONIC ENLARGEMENT IN INFANCY.

It is not uncommon to meet with cases of enlarged spleen associated with anemia in children under two and up to six years of age. The two common causes of this enlargement are syphilis and rickets, but cases sometimes occur independent of these affections. This condition does not correspond with Banti's disease in adults and most of the patients recover under proper medicinal treatment. In studying this group of cases, a knowledge of the normal blood conditions in infancy and childhood is absolutely necessary.

These diseases are not surgical.

An excellent résumé will be found in R. Hutchinson's Gulstonian Lecture.⁵

TRAUMA.

Injuries to the spleen by contusions, penetrating objects, and gunshot wounds are not uncommon, although the damage is not always limited to the spleen; the associated injuries of other organs being usually so extensive as to entirely mask the splenic injury.

Subcutaneous or internal rupture of the organ, that is to say, rupture in which the abdominal parietes show no solution of continuity, is the commonest and most dangerous form of trauma. Such an injury may vary all the way from a slight tear of the capsule to a complete morcellation of the spleen.

Mixer⁶ reports a splenectomy where, on opening the abdomen, one end of the

¹Tancini, I.: "Die Splenektomie und die Talma'sche Operation bei der Bantischen Krankheit," *Arch. f. klin. Chir.*, 1902, lxxvii, 874.

²Finkelstein, B. K.: "Splenektomie und Talma'sche Operation bei Malariaascites," *Centralbl. f. Chir.*, 1903, xxx, 1423.

³Roger, J.: "La splénectomie dans la maladie de Banti," *Presse méd.*, 1903, ii, 535.

⁴Loc. cit.

⁵Hutchinson, R.: "On Some Disorders of the Blood and Blood-forming Organs in Early Life," *Lancet*, 1904, i, 1253.

⁶Mixer, S. J.: "Cases of Laceration of the Spleen and of the Kidney followed by Recovery after the Removal of the Injured Organ," *Ann. of Surg.*, 1901, xxxiii, 713.

spleen was found torn entirely loose and lying free in the abdominal cavity, while the still attached portion was bleeding furiously.

Rupture of the spleen frequently leads to severe pain in the left epigastric region, but the condition is so frequently masked by collapse and exsanguination that a positive diagnosis before opening the abdomen is, as a rule, next to impossible. A history of a previously enlarged spleen is most suggestive, as it is the hypertrophied organs which rupture most readily. A large malarial spleen occasionally ruptures spontaneously.

Edler,¹ in an analysis of seventy-eight cases of splenic injury, found that in fifty-seven the spleen was the organ principally or solely involved, and out of these

fifty-seven spleens, twenty-four were found markedly diseased.

The indication for prompt surgical treatment in splenic rupture is most urgent, as a spontaneous recovery is practically unknown, and the safest and best surgical procedure, beyond all doubt, is a splenectomy. Suturing the ruptured spleen has been successfully done in a number of instances, but this consumes more time and is attended by greater risk than splenectomy, and it should be considered only in those cases where the tear is small in extent and the spleen otherwise normal.

Quick service should be the surgical motto, in a condition which is fairly comparable to a ruptured extrauterine pregnancy.

When the value of surgery was

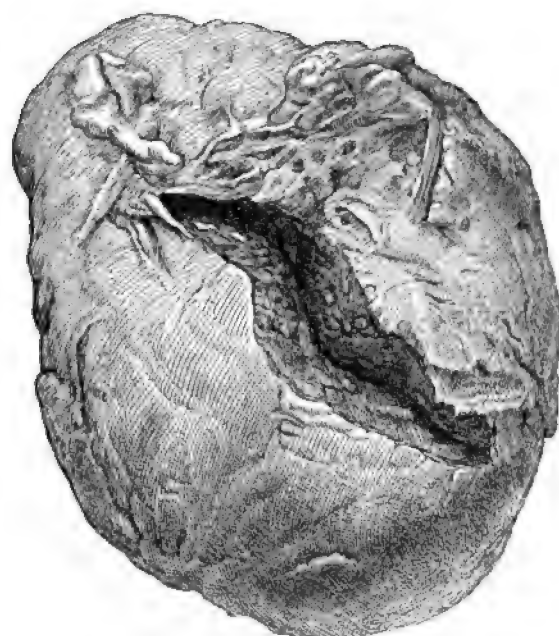


FIG. 781.—SPLEEN OF A SEVENTEEN-YEAR-OLD NEGRO GIRL, RUPTURED BY THE KICK OF A MAN IN HER LEFT SIDE. (Removed by Dr. E. A. Ballock, "Annals of Surgery," 1902.)

still questioned and late operations the rule, the mortality was almost 100 per cent., as Hartley pointed out as early as 1894. The commonest cause of death is hemorrhage, and next to that comes peritonitis. Vincent² found that out of one hundred deaths, seventy-five were due to hemorrhage.

M. Jordan³ reports three personal cases and adds twenty-five collected by Adelman⁴ in which the operation cured the patient.

¹Edler, L.: "Die traumatischen Verletzungen der parenchymatösen Unterleibsorgane," Arch. f. klin. Chir., 1887, xxxiv, 173.

²Vincent, E.: "Réflexions sur le pronostic et le traitement des ruptures de la rate," Rev. de chir., 1893, xiii, 449.

³Loc. cit.

⁴Adelmann, G.: "Die Wandlungen der Splenektomie seit dreissig Jahren," Arch. f. klin. Chir., 1887, xxxvi, 442.

Gunshot injuries to the spleen should be suspected from a study of the location of the wounds in the abdominal walls, but an accurate diagnosis comes only through an exploratory laparotomy, and the same principles govern here as in other splenic injuries; if there is considerable hemorrhage, the spleen should be removed.

A curious injury which occurs occasionally and deserves special mention is a hernia of the spleen through a wound in the abdominal wall; it has been known to escape entirely outside the cavity and for months remain on the surface, a fungous bleeding mass. If the case is seen soon after the injury, and if the organ is normal, it should be replaced in the abdomen, provided this can be easily done; under all other circumstances splenectomy is indicated.

CYSTS OF THE SPLEEN.

The cause and course of the development of splenic cysts is an obscure subject demanding further elucidation. The generally accepted view is that they begin with an extravasation of blood into the splenic pulp, ending by forming a so-called blood cyst; it is then conjectured that in a certain proportion of these cases the blood becomes absorbed and replaced by a serous fluid, thus accounting for the serous cyst.

Jordan, when reporting a personal case, found eleven others in the literature; he observed that the majority occurred in the third decade of life, and that out of the twelve cases, ten were women.

In June, 1895, a woman, thirty-eight years old, came to the Gynecological Clinic of the Johns Hopkins Hospital complaining of an abdominal tumor. Her family history was excellent and she stated that until the present illness her health had been of the best. In February of that year her attention was called to a small body in her left side by a slight pain at that point. The body continued to grow steadily until it reached the size of a child's head. I made a correct diagnosis before operation, and finding the spleen free, I first removed the cyst and then sutured the spleen. Convalescence was rapid and the patient has remained in the best of health up to this time (1907).

Cysts of the spleen rarely manifest themselves until they have reached considerable size, or occasioned sufficient discomfort to call the patient's attention to their presence.

Opening and evacuation with drainage is sufficient to insure recovery, but when the walls are thick and calcareous they should be removed by peeling out or by curettage. Bardenheuer has suggested a partial resection, when the cyst is favorably located.

When the adhesions are slight and there are a number of small cysts, splenectomy is indicated; Bessel Hagen collected seven cases successfully treated in this manner.

ECHINOCOCCUS CYST.

Cases of this disease are rare in America, where but few echinococcus infections of any kind occur. The disease is contracted from dogs, and the actual infecting agent is the larva of the *Tenia echinococcus*. The splenic involvement is practically always associated with cysts in other organs. Trinkler¹ collected seventy cases of echinococcus disease of the spleen, and he estimates that in 3.2 per cent. of all echinococcus infections this organ is involved.

The symptoms vary greatly, depending on the size and situation of the cysts. When these are small and deeply located, there may be no disturbances whatever; on the other hand, when they are large, and accompanied by pressure and by adhesions, great pain and discomfort are common.

In a differential diagnosis, cystic tumors of the other abdominal organs, and especially of the ovaries and of the kidneys, must be excluded. The demonstration of echinococcus cysts in other organs, associated with a history of exposure to the disease, aid in separating these tumors from other kinds of cysts of the spleen. Trinkler observed that in twenty-four out of fifty-one cases, fluctuation was noted, and that in eight, the peculiar crepitation and bruit characteristic of this kind of cyst was obtained. In some instances the diagnosis can only be made by a microscopic examination, with the demonstration of the characteristic hooklets.

The presence of such a cyst is a positive indication for operation, and splenectomy is the operation of choice.

In certain cases, when extensive and vascular adhesions are present, more conservative procedures have been employed. The cyst may then be emptied, and as far as possible its lining destroyed; great care should be taken to prevent the contents from coming into contact with the peritoneum or the abdominal incision.

J. Petit,² after draining such a cyst, saw cysts develop in the abdominal wall. On account of their danger, cysts of the spleen should be aspirated for diagnosis only after the abdomen is open and the spleen so isolated that infection of the peritoneum by escape of fluid is impossible. Jordan reports one personal case and adds seventeen from the literature, where splenectomy was done for echinococci; of these seventeen cases, but one was multilocular; thirteen were in women.

The evidence of extensive echinococcus disease of other organs is a contra-indication to operation.

ABSCESS OF THE SPLEEN.

The formation of abscesses in the spleen in cases of pyemia is a common occurrence, but such abscesses are usually small, and not recognizable during the life of the patient. Primary abscess in the spleen is rare. Douglas³ gives a résumé of seven cases reported by Bessel Hagen⁴ and adds three others.

¹Trinkler, N.: "Kyste hydatique solitaire de la rate," *Centralbl. f. Chir.*, 1894, xxi, 860 (ref.).

²Petit, J.: "Greffes d'un kyste hydatique de la rate," *Centralbl. f. Chir.*, 1901, xxviii, 120.

³Loc. cit.

⁴Loc. cit.

The origin of splenic abscess is frequently most obscure; a few have followed blows, and the case referred to under movable kidney followed a twisting of the splenic pedicle.

The clinical course is marked by septic fever, leukocytosis, loss of weight, and marked digestive disturbances, particularly diarrhea. Localized tenderness and pain are usually present and not infrequently an edema of the overlying abdominal wall is observed.

Abscesses of considerable size do not heal spontaneously; rupture into the stomach or into the intestines is commoner than through the abdominal wall. If adhesions are absent, or are such as can be readily dealt with, splenectomy is the operation of choice. Bessel Hagen reports seven cases successfully treated by this means.

When the spleen is adherent, the most effectual as well as the safest method of procedure is along the line employed by Lauenstein, in a case where, after exposing the spleen and sewing the capsule to the abdominal wall, he incised it with a Paquelin cautery, and then effectually established drainage. Such an operation is far from ideal, but it is the best under the circumstances.

TUBERCULOSIS OF THE SPLEEN.

Although it is not such a rare thing to demonstrate the spleen as the principal focus of a tubercular infection at the post-mortem table, primary tuberculosis of the spleen is most uncommon, and tuberculosis limited to the spleen belongs among the rarest conditions found at autopsies. In the general dissemination of tubercles accompanying an acute miliary infection, the spleen is almost invariably involved.

Although, when subjected to the rigid autopsy test, but few primary splenic tuberculosis seem to occur, they are more common clinically, and among other reliable writers on the subject, Joseph Bayer¹ has contributed greatly to our knowledge of this condition, through his collection and analysis of nine operative and nineteen autopsy cases.

In the early stages of the disease the patient may feel perfectly well. Pain in the splenic region is frequently present, and in the case of large abscesses may be intense. The spleen may not be materially enlarged, although it occasionally attains great size. When the disease is extensive and active, the fever, sweats, and chills characteristic of tuberculosis in other parts, may set in. In addition to anemia, hyperglobulia has been noted; there is no leukocytosis.

In making a diagnosis in a doubtful case, tuberculin might be given with advantage. The course of the disease is usually slow and extends over several years.

The operative indication is to do splenectomy as soon as the condition is diagnosed. In cases where large abscesses are present and the organ densely adherent, this procedure may have to be preceded by splenotomy with drainage.

¹Bayer, J.: "Ueber die primäre Tuberkulose der Milz," Mitth. a. d. Grenzgeb. d. Med. u. Chir., 1904, xiii, 523.

The general condition of the patient and the local condition of the spleen in the individual case will influence the operator as to the particular method to be employed.

Jordan quotes the successful operations of Marriot and Bland-Sutton, while Joseph Bayer found seven recoveries and two deaths in nine cases of splenectomy for splenic tuberculosis.

Extensive and active tuberculosis in other organs is a contraindication to any surgery other than opening an abscess which immediately threatens the life of the patient.

SARCOMA.

Although almost all malignant tumors of the spleen are of sarcomatous nature,



FIG. 782. SARCOMA OF SPLEEN.

(From W. Jepson and F. Albert, "Annals of Surgery," 1904.)

yet sarcoma of the spleen is rare. Up to 1894, splenectomy had been performed five times for this condition. Billroth's case (1884) died from recurrence six months after the operation; Fritsch's cases (1888) remained permanently well; Kocher's (1888) had a recurrence in the glands; Flothmann's (1889) died soon after operation, as a result of hemorrhage; Wagner's¹ was cured.

The symptoms are usually not pronounced during the early stages of the disease. In Wagner's case, above referred to, occurring in a woman twenty-three years of age, there were no subjective symptoms, but the patient noticed the mass in her abdomen.

Gastro-intestinal symptoms

are usually present, and in the later stages of the disease a marked ascites frequently develops.

The outlook of an untreated patient with sarcoma of the spleen is of course hopeless; the disease develops rapidly and invariably ends fatally. Splenectomy should be undertaken as soon as the condition is suspected. If the disease is in an early stage, the result ought to be a good one. When laparotomy demonstrates

¹ Wagner, W.: "Exstirpation der sarkomatösen Wandermilz." *Centralbl. f. Chir.*, 1894, xxi, Beilage 55. Dr. Wagner has died since his report, and his patient, who lived several years, has been lost sight of.

that the organ is densely adherent to the pancreas, the stomach, and the intestines, a permanent cure cannot be expected; and the primary mortality here is very great. It is easy to induce an uncontrollable hemorrhage, as in the unhappy experience of a great surgeon of my acquaintance.

SYPHILIS.

Enlargement of the spleen is common in congenital syphilis, and in infected syphilitic lesions amyloid change in the organ is frequent. Great enlargement may result from the presence of gummata; Hartley reports the successful removal of such a spleen. The local symptoms will depend on the size and location of the gummata; usually, marked evidence of tertiary syphilis will be found in other organs.

The treatment is medicinal, not surgical.

AMYLOID SPLEEN.

Moderate amyloid change in the spleen is not infrequently encountered at the autopsy table, and the tremendously enlarged sago-spleen is well known. Such a spleen is associated with amyloid changes in other organs, and the causes of amyloid disease, chronic suppuration, or syphilis are always present.

Vulpus¹ in 1894 collected three splenectomies performed for this condition. They all ended fatally. The condition is mentioned in order to note that it forms a contraindication to operation.

ANGIOMA CAVERNOSUM.

Hoge² reports the pathologic findings in a spleen removed for this condition by Hunter McGuire. The patient gave a history of alternating attacks of constipation and diarrhea, with marked loss of weight and strength. On examination, the spleen was found to extend all the way from the costal margin to the pelvis. Stuart McGuire writes that this patient has been lost sight of since leaving the hospital.

Homans³ reports a case with bloody ascites. His description sounds more like that of a sarcoma than an angioma cavernosum.

LEUKEMIA.

Leukemia, especially the spleno-myelogenous form, may lead to enormous increase in the size of the spleen, and it is not infrequent for the consequent enlargement of the abdomen to be the first and, it may be, only complaint of the patient. A few years ago, in one of the gynecologic wards of the Johns Hopkins Hospital, I

¹ Loc. cit.

² Hoge, M. D.: "Angioma Cavernosum of the Spleen," *Med. Rec.*, 1895, xlviii, 418.

³ Homans, John: "Report of a Case of Cavernous Angioma of the Spleen," *Ann. of Surg.*, 1897, xxv, 732.

cases of tuberculosis of the peritoneum as soon as the diagnosis is made. Three years later Kümmel reported 40 cases with operation, and in 1890 König¹ collected and presented at the Congress of Surgeons in Berlin 131 instances, including his own cases, that had been treated by laparotomy. In this second series of cases apparent cure was obtained in 84 instances, or 65 per cent., although in only 30 of the cases had the operation been more than two years prior to the date of the report.

Others soon followed, and in 1892 Lindner reported 205 cases; Aldibert, 308 cases; Roersch, in 1893, collected 358 cases; and Adossidies, in the same year, compiled 405 cases. In 1896, Margarucci collected 253 cases operated upon by members of the Italian Surgical Society, showing 216 instances, or 85.4 per cent. of cures. Since that time many sets of statistics dealing with the operative treatment of tuberculous peritonitis have appeared, and the careful study has led to a general employment of laparotomy in suitable cases.

At the same time that the surgical treatment of tuberculosis of the peritoneum was attracting so much attention various other features of the affection received a considerable amount of study. The different clinical forms of the disease were separated, the etiology and pathologic anatomy of this form of tuberculosis were carefully investigated, and the possibility of effecting a permanent cure by other than surgical means was insisted upon by several writers. Osler, in this country, gave the subject special attention, and he was the first to make a histologic study of the process of healing after abdominal incision. In an extensive monograph² in 1890, he took up the consideration of the disease in much detail and drew the following general conclusions:

First, that tuberculous peritonitis is often a latent affection, localized in the peritoneum, which may even run its course without inducing special symptoms.

Second, that, as in other local tuberculous processes, there is in this a natural tendency to healing, which takes place more frequently than has hitherto been supposed.

Third, that statistical evidence shows laparotomy to be in many cases a palliative, and in some instances a curative, measure.

The medical treatment of tuberculosis of the peritoneum has been strongly advocated by many writers on the subject. Borchgrevink, especially, has insisted on the internal treatment of this affection, and has supported his contention by the report³ of finding a spontaneous cure in 82.3 per cent. of cases so treated, as against the average primary result of cure by laparotomy, which he states to be from 65 to 70 per cent. Other papers either advocating or considering the medical treatment

¹König, F.: "Die peritoneale Tuberkulose und ihre Heilung durch den Bauchschnitt," *Centralbl. f. Chir., Leipz.*, 1890, xvii, 657-660.

²Osler, William: "Tuberculous Peritonitis. General Considerations. Tubercular Abdominal Tumors. Curability," *Johns Hopkins Hosp. Rep., Balt.*, 1890, ii, 67-113.

³Borchgrevink, O.: "Zur Kritik der Laparotomie bei der serösen Bauchfelltuberkulose. Ein klinischer und experimenteller Beitrag zur Lehre von der Bauchfelltuberkulose," *Mitt. a. d. Grenzgeb. d. Med. u. Chir., Jena*, 1900, vi, 434-450.

of tuberculosis of the peritoneum are those of Teleky,¹ Shattuck,² Osler,³ Schroeder,⁴ Sutherland,⁵ Hugentobler,⁶ and others.

ETIOLOGY.

Incidence.—It is now well recognized that tuberculous peritonitis is not a rare affection. The most extensive statistics bearing on this feature of the disease are those compiled by Engelmann.⁷ He found that of 2837 autopsies in a period of four years at the Munich Pathological Institute, 1.6 per cent. of all cases were tuberculous peritonitis; that of 8421 cases from the Berlin Pathological Institute which came to autopsy during ten years, 2.5 per cent. were from this disease. In Erlangen the statistics covering twenty-three years of autopsy records gave 1.4 per cent., and in Kiel 5425 autopsies in fifteen years gave 1 per cent. In these reports are cited only those cases which resulted fatally from tuberculous peritonitis; other forms of peritonitis, as are found in miliary tuberculosis or in grave tuberculous disease of other organs, are not here included. At the Pathological Institute of the University of Prague the statistics of tuberculous peritonitis covering 3500 autopsies include also the incidental finding of tuberculosis of the peritoneum, and give a percentage of 4.7 for this condition.

Bottomley,⁸ quoting from Nothnagel, states that from reported observations on tuberculous patients the peritoneum was involved in from 1.25 to 16.16 per cent., a wide variation. In his previously collected statistics⁹ he found that in 1170 autopsies at the Boston City Hospital from January, 1895, to January, 1900, tuberculosis was present in some form in 197 cases, and that in 14 of these the peritoneum was affected, *i. e.*, lesions of tuberculosis in 16.8 per cent. of all autopsies, and tuberculous peritonitis in 7.1 per cent. of these.

Boltz, quoted by Giuldjides,¹⁰ examined the cadavers of 176 tuberculous children and found the peritoneum affected in 27 instances, or 15.3 per cent. O. Müller found the peritoneum involved in 27 of 150 cases, or 18 per cent. Such figures as

¹Teleky, L.: "Die Bauchfelltuberkulose und ihre Behandlung." *Centralbl. f. d. Grenzgeb. d. Med. u. Chir.*, Jena, 1899, ii, 267-273; 326-328; 353-362.

²Shattuck, J. C.: "On Prognosis and Treatment of Tuberculous Peritonitis, Based on the Massachusetts General Hospital's Experience for the Past Ten Years" (Abstract), *Am. Med.*, Phila., 1902, iii, 808.

³Loc. cit.

⁴Schroeder, Emil: "Beitrag zur Kenntniss der Peritoneal-Tuberkulose," *Diss.* [Bonn.] Düsseldorf, 1897, 35.

⁵Sutherland, G. A.: "Prognosis of Tuberculous Peritonitis in Children," *Clin. Jour.*, Lond., 1903, xxi, 189-192.

⁶Hugentobler: "Die Peritonitis tuberculosa bei interner Behandlung," *Diss.* Zürich, 1902, 56.

⁷Engelmann: "Beitrag zur Kenntniss der Bauchfellentzündung, besonders der tuberkulösen Form," *Diss.* München, 1902, 34.

⁸Bottomley, John T.: "A Consideration of 28 Cases of Tuberculous Peritonitis at the Boston City Hospital, with Particular Reference to the Results of Operative Treatment," *Am. Med.*, Phila., 1902, iii, 265-268.

⁹Bottomley, John T.: *Idem.*, *Boston City Hosp. Rep.*, 1900, 11 s., 118-142.

¹⁰Giuldjides, Constantin: "Ueber Peritonitis tuberculosa und ihre Heilbarkeit durch Laparotomie," *Diss.* München, 61.

these indicate either that tuberculosis of the peritoneum *per se* is more common in children than in adults or that the lesions of tuberculosis are apt to be more easily disseminated and widespread in the young.

Primary tuberculosis of the peritoneum is very rare, and that it ever occurs is denied by some authorities. From our present knowledge of the subject, however, we are compelled to admit its possible existence. Bollinger estimates that it occurs in 3 to 4 per cent. of all tuberculous peritonitides. Mazzoni claimed that 16 of his 35 operative cases were primary. Borschka, on the other hand, from the study of 4250 autopsies showing 1393 instances of tuberculosis in the Pathological Institute of Breslau, found 226 cases of tuberculous peritonitis, and states that only two of these 226 cases were, without a doubt, primary in the peritoneum. Seiffert, quoted by Ansinn,¹ found 49 instances of primary tuberculous peritonitis in 1317 cases of tuberculosis of the peritoneum, or 3.7 per cent.

Age.—Tuberculosis of the peritoneum occurs at all periods of life. It is common in childhood, relatively rare in old age. Compiled statistics on this point show that the affection occurs most frequently between the ages of twenty and forty, although it is probable that the percentage in childhood would be larger were it not for the fact that most of the reported statistics are of cases treated surgically.

Rotch² states that tuberculous peritonitis may occur both in infancy and in childhood, while the most common age in children is from eighteen months to four years. Duval³ finds in his study of this disease in childhood that the majority of cases occur from six to twelve years of age. Giuldjides⁴ reports that of 1081 cases of tuberculous peritonitis that came to operation, 177 were in children, or 16.3 per cent.; while Krencki⁵ has compiled from the literature 266 cases that were operated upon, 63 cases, or 23.5 per cent., of which were in children.

Osler⁶ has added to his 21 cases, 69 of Boulland, 48 of Haene, 39 of Maurange, and 45 of Fenwick, together with 135 cases of Bristowe, Hilton Fagge, and Lebert; in all, 357 cases. These are arranged according to age as follows:

Under 10 years.....	27 cases
10 to 20 ".....	75 "
20 to 30 ".....	87 "
30 to 40 ".....	71 "
40 to 50 ".....	61 "
50 to 60 ".....	19 "
60 to 70 ".....	4 "
Above 70 ".....	2 "

Sex.—The opinion of various authors concerning the distribution of the disease among sexes is diametrically opposed. Surgeons and gynecologists assert that the

¹Ansinn, Kurt: "Beiträge zur Behandlung der tuberculösen Peritonitis mittelst der Coeliotomie." Diss. Greifswald, 1903.

²Rotch, T. M.: "Tubercular Peritonitis in Early Life; with Especial Reference to its Treatment by Laparotomy." Jour. Am. Med. Assoc., Chicago, 1903, xl, 69-73.

³Duval: "Péritonite tuberculeuse." Prat. méd.-chir. (etc.), Par., 1907, v, 237-240.

⁴Loc. cit.

⁵Krencki, J. von: "Ueber die Ausheilung der Peritoneal-tuberculose durch Laparotomie," Diss. Königs-berg i. Pr. 1902, 169.

⁶Loc. cit.

female sex is more commonly affected, whereas the majority of pathologists claim that the male sex is more subject to the disease. The reason for this lies in the fact that in the section statistics, or in the compilation of cases, of those treated internally the male sex is represented by about 70 to 75 per cent., while the statistical results of operative cases show more women than men.

Adossides found among 1066 tuberculous cadavers 766 men and only 300 women; Zahn, 1357 men and 701 women in 2058 cadavers. Of 153 cases collected by the pathologists Phillips and Muenstermann, 122 were in men and 31 in women. There is one possibility of error which should be eliminated from post-mortem statistics, and we are not informed if that was done in the above series, and that has to do with the relative number of male and female subjects which come to autopsy. As a general rule, many more males than females are subjected to autopsy, and unless this fact is taken into consideration such sets of figures are much invalidated.

Operative statistics seem to show that the disease is far more common in women than in men; as, for example, of 386 cases reported by König, Lindner, Kümmel, and Roosenburg (all surgeons), 36 were in men and 350 in women.

Giuldjides is of the opinion that in spite of the discrepancies in figures the disease is *de facto* more frequent in women than in the opposite sex.

As regards sex in children, it will be seen that it plays no part of special importance. Of 186 cases in children reported by Schnitz, Boltz, Fink, Frick, Gassel, and Rotch, 96 were boys and 90 were girls.

Nothnagel says: "Sex plays a peculiar rôle in our statistics; among the cases discovered after death there are many more males, none of whom died after operation, while among the subjects who were operated upon for the disease many more women (90 per cent.) were found. This is probably due to the fact that in women operations are more often performed because some other diagnosis is more commonly made—diseases of the sexual organs."

Factors Governing Infection.—The same factors which predispose to tuberculosis in general also obtain as regards the form of the infection involving the peritoneal membranes. These include: (a) the family history of tuberculosis; (b) poor hygienic environment, especially during infancy; (c) a constitution of feeble resistant power; (d) a severe infective illness in early life; (e) chronic diseases of the kidney, liver, blood-vessels, etc., in which tuberculosis of the serous membranes is not uncommonly a terminal event.

The exciting cause of tuberculosis of the peritoneum is the invasion of the serous membrane by the bacillus of Koch. In view of the bactericidal property of the peritoneal fluid, which, according to Nötzel, is apparently greater than that of the blood-serum, the predisposition of this cavity to tuberculous infection is slight. Diminished peristalsis is said to favor the foothold of the tubercle bacillus by retarding the dissemination of the micro-organisms so as to be acted upon by the protective secretions.

Strümpell and Osler both believe that chronic intestinal catarrh is a predisposing cause, especially in children.

Stasis of the portal system has been thought by some writers to favor the occurrence of tuberculous peritonitis because of the frequent association of this disease with cirrhosis of the liver. Some authors consider tuberculosis of the peritoneum primary in this class of cases, and believe that the growth of interstitial tissue in the liver emanates from the tuberculous capsule and only secondarily invades the liver substance. Weigert and Chiari, on the contrary, hold that the cirrhosis of the liver is primary, and that the resulting ascites furnishes a favorable culture-medium for the growth of bacilli which enter the abdominal cavity. *A priori* one would suppose that a certain degree of venous stasis would be inimical to the lodgment and flourishing of the tubercle bacillus, reasoning by analogy from the brilliant results obtained in tuberculous arthritis and other forms of infection by the artificial stasis secured by the employment of Bier's methods of treatment. It seems much simpler to attribute the occurrence of tuberculosis of the peritoneum in hepatic and other chronic disorders to the lowered resistance in the individual who is so affected. In this same manner can be explained the views of Courtois-Suffit and others who look upon alcoholism as the predisposing cause, as it is so frequently associated with tuberculous peritonitis and hepatic cirrhosis.

In many instances the peritoneal lesions are secondary to tuberculosis of the intestine, and in all cases of tuberculous ulceration of the gut small yellow tubercles can be demonstrated lying just beneath the serous surface of the ulcerated areas. It has been frequently shown, however, that tubercle bacilli may pass through the intestinal wall without producing any lesions. Most interesting in this connection are the experiments of Ravenel.¹ He fed fasting animals with a mixture of tubercle bacilli and butter, and three and one-half hours later examined the thoracic duct and mesenteric glands by inoculation, and demonstrated the presence of tubercle bacilli in these structures. Working along this same line, Whipple² was able to demonstrate tubercle bacilli in smears made from the contents of the thoracic duct in 16 out of 27 cases of various forms of tuberculosis that came to autopsy.

In the largest number of cases, says Nothnagel, the lungs are primarily affected, while no other abdominal organ except the peritoneum shares in the infection. In some cases tuberculosis of the peritoneum follows a glandular tuberculosis; in a large number of cases, perhaps in the majority, the condition is associated with tuberculous infection of the pleura. In other cases, again, the tubercle bacillus displays a special preference for the serous membranes, and we find the pericardium, pleura, and meninges also involved in the tuberculous process.

Primary tuberculosis of the genitalia plays an important part in the etiology of tuberculous peritonitis, particularly in women. Phillips, Mazzoni, Borschka, and Sick collected 414 cases of tuberculosis of the peritoneum in which the primary focus occurred 47 times in the genitalia of women and 27 times in the genitalia of men. Phthisis was also present in 81.8 per cent. of these 414 cases. In 77 cases

¹Ravenel, Mazyck P.: "The Passage of Tubercle Bacilli through the Normal Intestinal Wall. (A preliminary report.)" Jour. Med. Research, Boston, 1903, n. s., v, 460-462.

²Whipple, G. H.: "Disseminated Tuberculosis in Relation to the Thoracic Duct and Vascular Tubercles," Johns Hopkins. Hosp. Bull., Balto., 1906, xvii, 270-272.

collected by Frees, Hegar, Zweifel, Casivari, Spaeth, Löhlein, Gerard-Marchant, Edebohls, and Küstner, the primary focus was in the genitalia in 33 of the cases, about 42 per cent. Aldibert found primary tuberculosis of the genitalia in 56 per cent. and Adossides in 63 per cent. of their cases. Tuberculous salpingitis, or the infection of the uterus, vagina, or ovaries, can all be the starting-point of the peritonitis in women, while in men tuberculous disease of the epididymis or seminal vesicles may play a like rôle.

PATHOLOGY.

Tuberculosis of the peritoneum may be divided according to its pathologic anatomy into acute and chronic types. The acute form of the disease has as its anatomic picture a general dissemination of miliary tubercles involving the parietal and visceral layers of the peritoneum. The chronic type is subdivided into an ulcerative or suppurative form, and a fibrous or adhesive form. This is the usual classification adopted by American writers. The majority of French authors classify tuberculous peritonitis as follows: (1) Miliary form. (2) Fibrous form: (a) dry fibrous form; (b) free ascitic form; (c) ascitic encysted form. (3) Ulcerous, or caseous, form: (a) dry caseous form; (b) caseous purulent form. Most German writers on the subject recognize: (1) Exudative type with (a) free ascites and (b) localized ascites; and (2) the dry type of the disease.

In the *acute miliary tuberculosis* of the peritoneum the serous membrane covering the intestines, omentum, mesentery, and the various organs in the abdomen, as well as the parietal peritoneum, are studded with numerous small yellowish tubercles. These vary in size from 0.5 to 5 mm. in diameter, are for the most part discrete, and are superficially situated. The tubercles are most numerous on the serous surface of the intestines and in the omentum and mesentery, but are especially thick in the capsules of the liver and spleen. As a rule, the intestines are not matted together nor is the abdominal cavity partitioned off. An excess of fluid is almost always found and, according to the majority of authors, the abdomen regularly contains a considerable amount of exudate, consisting of citrinous serum, often sero-fibrinous, sometimes sanguineous, rarely sero-purulent. Some writers do not believe that this form of peritonitis is always associated with ascites, and among these are Borschka, who found among 16 cases of miliary tuberculosis in his series of 226 cases only two which showed a serous exudate.

In the *chronic ulcerative* forms of tuberculosis of the peritoneum the serous membrane is covered with a false membrane of soft, yellowish consistency. This exudate may be converted in places into cicatricial masses, so that the loops of intestine become agglutinated by the fibrous material or become adherent to the abdominal wall, liver, spleen, and pelvic organs. The adherent coils of intestine often cause the exudate to become sacculated, and on opening such an accumulation of fluid it is often found to be of a purulent nature, and may be of a chocolate color, due to its mixture with altered blood. Encysted foci are encountered in various parts of the abdominal cavity and give rise to large tumor-like masses. Very remark-

able examples of this are seen in certain instances in which the exudate is confined to the lesser peritoneal cavity, as the foramen of Winslow becomes closed by exudate, and a large rounded tumor appears in the epigastrium or mid-abdomen. The mesenteric glands are always affected and the process often extends to the pleura, pericardium, and lungs. The intestinal walls are usually much infiltrated and are friable and easily torn. This form of tuberculosis is essentially ulcerative and is prone to cause either a perforation of the intestine, forming a cloaca infected with a mixture of intestinal and peritoneal fluids, or the ulceration may lead to the formation of an external fistula, most often at or near the umbilicus. The tendency of this form of peritonitis is to ulceration and the formation of cicatricial tissue, so that spontaneous cure is exceptional.

Chronic fibrous tuberculosis of the peritoneum may be subacute from the outset or may represent the final stage of the acute miliary form of the disease. In the early stages of this form the abdomen contains a moderate or an abundant amount of exudate, which is yellow in color and of a serous consistency, but may be sanguinolent or sero-purulent. The fluid at first is free in the peritoneal cavity, while the tubercles on the serous surfaces are usually hard and pigmented. As the process advances, however, vascular granulations lead to the formation of connective tissue. Hence cicatricial contractions occur, adhesions form in the peritoneal folds, portions of the exudate may become encapsulated, the omentum is often contracted into a tough, thick cord lying transversely across the epigastrium so as to form a prominent tumor mass, and the scarring and contraction of the mesentery may draw the intestine into a small knot against the spinal column. If the cicatricial process develops more rapidly than the tuberculous growth, the latter may be well encapsulated by fibrous tissue, and spontaneous cure ensue here just as it does in the lungs or other organs which are the seat of tuberculous disease. The exudate then disappears, resulting in the dry form of the disease.

SYMPTOMATOLOGY.

The clinical manifestations of tuberculosis of the peritoneum are very variable, so as to present a "symptom-complex of extraordinary diversity." The disease may run an acute, a subacute, or a chronic course, while in other instances it is entirely latent.

In the *latent form* there is often not the slightest suspicion of tuberculosis entertained, and the condition becomes known only when the abdomen is opened for other reasons. Every gynecologist has had this experience, and it is in just these cases that the operator should carefully look for a primary focus, especially in the adnexa.

The *acute type* of tuberculous peritonitis may set in very suddenly in an individual previously free from all abdominal symptoms. In such instances the usual diagnosis is strangulated hernia or acute appendicitis, so that the patients have come to operation at once. In other cases of the acute type the patient may present all

the features of an active septicemia, chills, irregular fever, and sweats, with few if any signs directing attention to the abdomen, so that the diagnosis is made with much difficulty, or, indeed, is often deferred until some localizing symptom makes its appearance. The careful study of the blood is of particular value in arriving at a conclusion in this class of cases, while the discovery of an enlarged, nodular epididymis, a pleural friction, or an infiltrated apex often gives the clue to the situation.

The most common form of tuberculous peritonitis one meets with falls into the category of the *subacute type*. The clinical picture is quite definite, as a rule, and the diagnosis is usually made. There are cases, however, to which Osler and others have called attention, which, with a slow onset, abdominal tenderness, persistent tympanites, and a low continuous fever, simulate typhoid fever most accurately. The blood picture, too, resembles that found in enteric fever, and a positive diazo reaction is frequently obtained. The Widal test, however, is continuously negative, but it is just here that the serum reaction does not help us, as it may be absent in from 3 to 8 per cent. of all typhoid infections. Recently the extended employment of blood cultures has proved of distinct value in excluding typhoid fever and other forms of septicemia. Tuberculin is of the greatest value as a means of diagnosis and should be used in all clinically doubtful cases.

Chronic Tuberculous Peritonitis.—The ordinary type of subacute tuberculous peritonitis merges into the chronic form, so that they can be best described together. In general, the constitutional symptoms consist of weakness, loss of weight, anorexia and perhaps vomiting, and intestinal derangement. As a rule, there is constipation, which, indeed, may be marked, while if diarrhea is present it is usually associated with tuberculous ulceration in the intestine. Fever may or may not be present. The majority of cases run a slight irregular temperature, but in some instances the temperature curve may be subnormal over long periods of time, an expression of the lowered state of nutrition with a non-active inflammatory process. An early symptom is abdominal discomfort, which is more or less persistent and may develop into actual pain, either general or localized. The anatomic picture, post mortem, is very often out of all proportion to the subjective symptoms noted during life. Tympanites is a common symptom and is most often due to the loss of muscular tone in the infiltrated intestinal walls, although it may be caused by partial constriction due to adhesions or to excessive fermentative changes in the intestinal contents, particularly if there is an associated intestinal tuberculosis. In some instances there is a striking pigmentation of the skin, even without involvement of the adrenals, so as to suggest the diagnosis of Addison's disease. A periomphalitis, or inflammation in the neighborhood of the navel, when it occurs, is of considerable diagnostic importance.

The two most valuable signs of tuberculosis of the peritoneum have to do with the presence of an exudate and with tumor formation. Ascites almost always accompanies this form of inflammation of the peritoneal membranes.

In most instances the amount of effusion is moderate, but it may be so abundant as to cause marked distention, and so induce considerable embarrassment of the

heart and respiratory apparatus. The fluid is usually serous, of a bright yellow or straw color, contains albumin, usually coagulates spontaneously on standing; the cellular elements consist of desquamated endothelial cells and mononuclear leukocytes; occasionally red blood-cells and pus-cells are also present. The fluid contains the offending micro-organisms in small numbers, as they may sometimes be found by the inoscopic method suggested by Jousset,¹ and have also been isolated by inoculation. The effusion may be sero-fibrinous or hemorrhagic, or at times purulent. The fluid is often free, but it may be encapsulated in various regions within the abdomen.

The tumor formations may be due to several causes. In the first place, the sacculated exudations just mentioned give rise to small or large swellings, which are usually rounded, of a firm consistence, and not, as a rule, movable. The encysted exudate is most commonly found in the middle zone, where it may be mistaken for an ovarian cyst; another rather frequent situation is in the lesser peritoneal sac, forming a large rounded mass in the epigastrium lying more on the left side than on the right. Associated with tuberculous disease of the Fallopian tubes the sacculated exudate may lie entirely within the pelvis proper. A second form of tumor is that due to a thickened, rolled-up omentum, which then lies as a sausage-shaped mass transversely across the abdomen just above the level of the umbilicus. This is the most constantly found variety of tumor mass in tuberculous peritonitis, but a similar rolling of the omentum may occur in peritoneal carcinomatosis. A third form of tumor formation, which is quite rare as compared with the preceding two, is due to infiltration and cicatrization of the mesentery, which, by its contraction, draws the intestines into a knot down against the spinal column, and, together with the great thickening of the walls of the intestines, forms a more or less firm, scarcely movable mass.

A fourth form of tumor growth is found most frequently in children, giving rise to the condition commonly known as *tabes mesenterica*, and is caused by the involvement of the mesenteric and retroperitoneal glands in the tuberculous process. The recognition of these tumor formations is often rendered difficult in the presence of ascites, but if the abdomen is tapped they can usually be mapped out without difficulty.

DIAGNOSIS.

In probably the majority of cases the diagnosis is correctly made when the patient is first seen, at least in the subacute and chronic forms of tuberculosis of the peritoneum. The chief points of value in arriving at this conclusion may be conveniently arranged as follows:

1. The history of a family tendency to tuberculosis is of some importance as a predisposing factor to the infection.
2. The presence of a tuberculous lesion elsewhere in the body is very strong evi-

¹ Jousset, André: "Nouvelle méthode pour isoler le bacille de Koch des humeurs de l'organisme," *Semaine méd.*, Par., 1903, xxiii, 22-24.

dence that any irritative signs occurring in the abdominal cavity have a like etiology. In this connection it may be stated that the simultaneous inflammation of any two serous sacs of the body is almost always of tuberculous origin. The occurrence of salpingitis in the female, or of a nodular epididymitis or seminal vesiculitis in the male, may give the clue.

3. The general state of nutrition is usually much impaired, although the affection may attack an apparently robust individual. Special features associated with malnutrition are the anorexia, intestinal disturbances, and abdominal discomfort.

4. The examination of the abdomen usually reveals the presence of an effusion. If this is withdrawn, or if, without tapping, one is able to make out multiple masses, the diagnosis is at once limited to either tuberculosis or malignant new-growth with metastases.

5. Among the special examinations that may be employed to advantage are: (a) The tuberculin test. In a clinically doubtful case it is quite feasible to employ tuberculin if the patient is afebrile. The dose at first should be small, certainly not over one milligram, as the resulting reaction in a positive case may be marked. This is a most valuable diagnostic procedure, and Halsted, of Baltimore, says that he has never known it to fail in cases of tuberculous peritonitis. (b) The diazo reaction of the urine is given as constantly in tuberculosis of the peritoneum as, if not more so than, in typhoid fever, and a marked positive test is strong corroborative evidence. (c) The examination of the blood shows a mild grade of secondary anemia, except in those cases in which the blood may be concentrated by diarrhea. As a rule, the leukocytes are not increased, and if a leukocytosis does occur, it is the result of a secondary infection. In the usual run of cases the differential count is either normal or may show a relative increase in the mononuclear elements commonly found in all conditions of poor nutrition. (d) The examination of the ascitic fluid has shown that the study of the cellular elements is of practically no aid in making a diagnosis, as the character of the fluid in this respect does not differ from that produced by certain other conditions associated with a peritoneal effusion. Tubercle bacilli are present in the exudate, but in such small numbers as sometimes to escape even the inoculation test.

6. In clinically obscure cases, when all other means of arriving at a conclusion have been tried, a simple exploratory operation is amply justified.

DIFFERENTIAL DIAGNOSIS.

The chief difficulties that one encounters in making a correct diagnosis are in connection with the following conditions:

1. Ascites associated with cirrhosis of the liver. Fever and pain may be equally absent in both affections, and even the fact that after paracentesis the liver is found to be diminished in size does not alone decide the question, for the two affections may occur together, the hepatic cirrhosis either favoring the development of the tuberculous peritonitis, or the cirrhosis developing as the result of the peritonitis.

The chief points in favor of the cirrhosis are to be found in the alcoholic history, the collateral venous circulation, the indolence of the abdomen, splenomegaly, and the frequent occurrence of hemorrhoids and of epistaxis. Syphilis of the liver is nearly always accompanied by an enlargement of this organ, but in the later stage one may find a shrunken, scarred liver, as in the cirrhosis of Laennec, and it is with this form that tuberculous peritonitis may be confounded.

2. Abdominal tumors not due to tuberculosis. These may arise in any of the abdominal organs, stomach, intestine, gall-bladder, kidney, glands, female generative organs, etc. These growths, as a rule, are single; so also, of course, may be the tuberculous tumor. The most easily palpable tuberculous mass, the rolled-up omentum, is of such characteristic shape and position that the diagnosis will be instinctively first directed toward tuberculosis. In order to differentiate this tumor from a gastric carcinoma the chemical reaction of the gastric secretion must be investigated. Cysts of the ovary have frequently been mistaken for tuberculous masses, and vice versa. In ovarian cysts, however, the fluid is not usually as free and is of a different character, the abdomen is uneven and more prominent anteriorly, and the intestinal tympany is present in the flanks, while the percussion note is dull at the higher points. Sometimes, however, the differential diagnosis is not easily attained in these cases.

3. A far less pardonable mistake is sometimes made by operating upon an individual who is subject of a purely neurotic disorder. It is sometimes puzzling to distinguish the pain, abdominal tenderness, flatulence, constipation, etc., of an intensely neurotic woman from a true organic lesion. That these patients are not infrequently needlessly subjected to surgical procedures has been often written of by Dubois¹ and others. The most consummate skill is often required to recognize the hysterical stigmata so as not to be misled in these not uncommon cases.

PROGNOSIS.

Until 1884, when König first proposed surgical intervention for the cure of tuberculosis of the peritoneum, the gravest apprehensions were entertained in regard to this disease; indeed, it was considered almost invariably fatal. Up to this time all instances of spontaneous cure were looked upon as mistakes in diagnosis. The great impetus that was given to the study of this affection in the next succeeding years brought forth undoubted cases of tuberculosis of the peritoneum that spontaneously resolved. This happy event seems to be not uncommon in children, according to Chaffee and Hilton Fagge, while Nothnagel, Nassauer, Marfan, and many others have shown that there is a tendency to healing in many cases in adults, and that spontaneous cure does occur. Probably the first positive proof of this was the case of tuberculous peritonitis seen at operation by Hegar, in which, on the occasion of a later laparotomy, all signs of the pre-existing lesions had entirely disappeared.

¹ Dubois, P.: "The Psychic Treatment of Nervous Disorders," 1906, New York.

After the treatment by celiotomy was instituted, surgical intervention was looked upon as a panacea for this hitherto hopeless affection, and, heedless of a few dissenting voices, surgeons all over the world began to operate for this condition, and for the next fifteen years—until 1899—reported recoveries in from 70 to 85 per cent. of their cases. The time of observation was far too short, however, in these series collected from the literature, because cases were included that had been operated on for only a few months. For example, Cellier reported 71 per cent. of recoveries in a total of 287 cases shortly after operation, which dwindled down to 25 per cent. when the patients had been under observation for two years or more. Many authors, including von Winckel, Halsted, and others, do not consider that a patient can be said to have recovered from the disease unless he has survived for five years, and this, of course, applies to those treated medicinally as well as to those operated upon. Having in mind that the vast majority of statistics bearing on the subject are to a certain degree misleading, we may now discuss the prognosis according to the two methods of treatment, hoping that in the course of the next few years we may be able to speak with more certainty.

The Prognosis as Affected by Surgical Treatment.—Giuldjides,¹ in 1902, was able to collect 1081 cases of tuberculosis of the peritoneum that had been treated by laparotomy with 778 cures, or 72 per cent. These were compiled from the following authors:

AUTHORS.	CASES.	CURES.	PER CENT. RECOVERIES.
Adossides.....	405	278	69
Bartz.....	3	3	100
Baumgarten.....	24	16	67
Beaussenat.....	7	6	86
Ebstein.....	14	9	64
Ferri.....	23	14	61
Fink.....	2	2	100
Firchau.....	16	10	63
Frees.....	18	6	33
Gassel.....	7	4	57
Gluck.....	30	19	63
Gross.....	12	7	58
Hertzfeld.....	29	18	62
Hintenberger.....	19	9	47
Israel.....	4	4	100
Kissel.....	35	27	77
Knapmann.....	7	5	71
Lauper.....	14	10	71
Lejars.....	2	2	100
Margarucci.....	253	216	85
Mazzoni.....	35	33	97
Merkel.....	2	2	100
Psaltoff.....	40	25	63
Sadillo.....	43	29	67
Scheuer.....	13	7	54
D'Uso.....	3	3	100
Valenta, Jun.....	19	12	63
Warneck.....	2	2	100
Total.....	1081	778	72

¹ Loc. cit.

A similarly arranged set of statistics compiled from American operators shows 294 cases of tuberculous peritonitis subjected to operation with 233 recorded recoveries, or 79 per cent., as follows:

AUTHORS.	CASES.	CURES.	PER CENT. RECOVERIES.
Abbe.....	2	2	100
Bottomley.....	28	11	39
Gray.....	10	7	70
Hall.....	110	90	82
Lloyd.....	21	17	81
Mayo.....	26	25	96
Ochsner.....	32	15	47
Rotch.....	32	20	63
Shattuck.....	52	46	88
Total.....	294	233	79

Halstead,¹ writing in 1903, calls attention to the fact that up to that time over 1500 cases of peritoneal tuberculosis treated by laparotomy have been recorded. From these reports it is evident that the prognosis depends largely upon the anatomic form of the disease. In the exudative or ascitic form the prognosis is most favorable, and he places a conservative estimate of 40 to 50 per cent. of cures in this type. The adhesive form gives a more unfavorable prognosis in that at most only about 25 per cent. recover. In the ulcerative caseating variety the benefit of laparotomy is questionable. More carefully prepared statistics are those of Wunderlich.² He has compiled 500 cases of tuberculous peritonitis which have been treated surgically and in which a more or less complete history of each case is given. The results in these cases have all been noted at a period of three years or more since operation, and he summarizes the results as follows:

Ascitic form.....	314 cases, 68.8%.	Cures in 23.3%.
Fibro-adhesive form.....	136 " 27.2%.	" " 9.8%.
Ulcerative form.....	20 " 4.0%.	Cures none.

The chief factor in the prognosis of surgically treated peritoneal tuberculosis has to do with the removal of the primary focus of the disease. If this is localized and can be extirpated, the chances for recovery are of the best. Aside from this, the prognosis is much more serious, and in complicated forms of tuberculous peritonitis the prospect may be much changed by meddlesome surgical interference. The conclusions of Sutherland's paper (*loc. cit.*) have to do particularly with the factors of prognosis, and are as follows:

1. In uncomplicated tuberculous peritonitis the prognosis is good.
2. When tuberculous pleurisy is present the prognosis is still favorable.
3. The prognosis is rendered less favorable in the case of (a) a strong family history of tuberculosis; (b) an infancy passed under bad hygienic conditions; (c)

¹ Halstead, A. E.: "Tuberculous Peritonitis," Am. Med., Phila., 1903, v, 176-179.

² Wunderlich, Otto: "Ueber die Misserfolge der operativen Behandlung der Bauchfelltuberculose," Arch. f. Gynak., Berl., 1899, lix, 216-276.

a constitution of feeble resistant power; (d) or a history of severe infective illness in early life.

4. The prognosis is rendered less favorable in the presence of one or more of the following symptoms: continuous pyrexia, rapid wasting, persistent diarrhea, rapid pulse, and recurrent acute exacerbations.

5. It is rendered less favorable in the presence of one or more of the following local complications: (a) tuberculous ulceration of the bowel; (b) extensive caseation of the mesenteric glands or of tuberculous masses; (c) localized suppuration from infection through glands or the intestine; (d) obstructive symptoms from bands or matting of the intestine.

6. It is bad in the presence of: (a) the rupture of a suppurating gland, or the perforation of an intestinal ulcer into the peritoneal cavity; (b) pulmonary tuberculosis; (c) tuberculous meningitis; (d) general miliary tuberculosis.

This writer further concludes that the prognosis is not appreciably affected by simple laparotomy.

To this last statement of Sutherland's many men of experience will take exception. It has been generally accepted that the simple opening of the peritoneal sac exerts a distinct beneficial influence on the course of tuberculous disease involving it. The theories to explain this seeming phenomenon are nearly as numerous as the writers on the subject. Although it cannot be denied that cures have followed this measure, yet in the past few years some doubt has been cast on its efficacy as a remedial measure. Many writers still contend for its superiority over ordinary puncture and withdrawal of the effusion.

Regarded in the light of an exploratory operation with the possibility of finding and removing a primary focus of the disease, surgical interference is most certainly justified. Otherwise the favorable result following a simple laparotomy cannot be proved to be entirely due to the operation *per se*, as there is always the possibility of a spontaneous cure by Nature's resources. This point is still unsettled and must remain so for the present.

In view of the fact that the mortality rate from laparotomy in cases of tuberculosis of the peritoneum is so low, being estimated at from 1 to 3 per cent., and in view of the fact that nearly all cases operated on are temporarily improved (provided the surgeon does not try to do too much), and as sepsis is not likely to occur, and particularly as there is a chance for permanent benefit, it seems justifiable to operate early in all operable cases.

The Prognosis as Affected by Medicinal Treatment.—Borchgrevink¹ was one of the first to insist very strongly on the medical treatment of tuberculosis of the peritoneum, even to the extent of condemning all surgical procedures. To a certain degree, he has had many followers, and Fenger,² speaking of Borchgrevink's results, says: Borchgrevink has brought the subject back to a rational basis by

¹ Loc. cit.

² Fenger, Christian: "Treatment of Tuberculosis of the Peritoneum," *Ann. Surg., Phila.*, 1901, xxxiv, 771-786.

most scientific and careful observation of two almost equal series of cases of peritoneal tuberculosis, one of which was treated by laparotomy and the other without operation, 22 cases in the first group and 18 in the second. Of the 22 cases operated on, 11 patients had fever, while in the other 11 fever was not present; of these latter, 10 lived and 1 died; of the 11 with fever, 8 died and only 3 were cured. In 17 cases conservative treatment was employed; of these 14, or 82.3 per cent., recovered and were still well, or at least clinically cured, after two or three years. Of the three patients who died, the death was due in one instance to tuberculous peritonitis, in a second to intestinal tuberculosis after six months, and in a third to measles after five months. His conclusions from his cases are the following:

1. That laparotomy in strong patients, in whom fever is absent and in whom a condition of good nutrition speaks for a spontaneous disappearance of the tuberculous process, is well tolerated.

2. Laparotomy, however, in patients with fever, when the tuberculosis has a progressive character, must diminish what slight resistance such a patient has remaining. This power of resistance may thus yield, and death follow, or it may, by concurrence of fortunate circumstances, rebound and the patient recover in spite of the operation.

3. That form of peritoneal tuberculosis which exists without fever, or with only slight fever, runs in itself a favorable course. In such a case laparotomy is unnecessary. In progressive tuberculosis the operation is dangerous and should be abandoned.

Borchgrevink does not hesitate to add that even the "serous tuberculous peritonitis is a territory which surgery must hand back to the internal-medicine clinic with thanks for the splendid opportunity which a misunderstanding gave to the profession, by means of laparotomy, to study tuberculosis in one of the large cavities of the body."

On the whole, statistics as to the value of medical treatment of tuberculous peritonitis are not very complete, and it is difficult to say just what proportion of cases end in spontaneous recovery because of the uncertainty of diagnosis. 'Shattuck'¹ reports on 98 cases of tuberculosis of the peritoneum, 46 of which were treated without operation with apparent recovery in 39, or 84.8 per cent., while of the 52 cases operated upon 46, or 88.4 per cent., recovered. Sutherland² considers the prognosis from the result of 41 cases of tuberculous peritonitis treated at Paddington Green Children's Hospital. Twenty-seven cases were treated medicinally, and of these 22, or 81.3 per cent., recovered; 1 case was unrelieved; and 4, or 15 per cent., died. Of the 14 cases treated by laparotomy 7, or 50 per cent., recovered, and the same number of cases died.

Hugentobler³ has reported 67 cases treated internally at Eichhorst's clinic, with 25 per cent. of cures, and compares his results with those of Rose, from the medical clinic at Strassburg, numbering 71 cases. Of Rose's cases, 51 had been under observation for a long enough period to justify definite conclusions, and showed:

¹ Loc. cit.

² Loc. cit.

³ Loc. cit.

Cured: 16 cases, or 31 per cent.; not cured: 1 case, or 2 per cent.; died: 34 cases, or 67 per cent. Hugentobler's cases are arranged as follows:

AGE.	CURED.	IMPROVED.	NOT CURED.	DIED.	TOTAL.
1-10	1	1	..	3	5
11-20	6	2	2	4	14
21-30	5	7	3	5	20
31-40	3	1	3	8	15
41-50	1	..	1	2	4
51-60	1	..	..	4	5
61-70 .....	..	1	1	2	4
Total	17	12	10	28	67

Schroeder¹ reports 41.6 per cent. of cures in a total of 24 cases treated in the medical clinic at Bonn, and Pic (quoted by Giuldjides) says that a spontaneous cure may be expected in 20 per cent. in adults and in 33 per cent. in children, while contending that laparotomy cures 85 per cent.

By comparing the statistical results of cases that have been observed for a sufficient time after treatment, one is impressed with the fact that the figures are about the same in those treated surgically as in those treated by medicinal means, and one may conclude that the prognosis for recovery is good in from one-fourth to one-third of all cases of tuberculosis of the peritoneum.

TREATMENT.

Indications and Contraindications for Operation.—The operative treatment of tuberculous peritonitis may be expected to yield the best results in those cases in which the lesion is primary within the abdomen, particularly if the primary focus can be safely extirpated. As it is generally conceded that the ascitic form is most likely to be primary in the peritoneum, this would be the most favorable type on which to operate, and compiled statistics seem to bear this out. It is a fact, says Duval,² that ascitic tuberculous peritonitis furnishes the most constant and permanent successful operations; sometimes these forms may be cured spontaneously, but the hope of cure is enhanced if the operation is done early.

The indications for operation in the ulcerative and fibrous forms of tuberculosis of the peritoneum are variously discussed by different operators. Billings, of Chicago, feels that in these groups the surgeon merely writes the death certificate, and to this opinion Halsted, of Baltimore, and Shattuck are also inclined. Other operators feel that the operative chances in these cases are still encouraging, as, for example, Aldibert, who reports cures in the ulcerative caseous form of the disease in 59.1 per cent. of primary results, permanent cure in 15 per cent., while the mortality rate was 40 per cent.

The fibrous form of tuberculous peritonitis may demand surgical intervention because of such complications as obstruction of the bowel by adhesive bands, and

¹ Loc. cit.

² Loc. cit.

because of the involvement of nervous and vascular trunks causing functional disturbances and pain. Aside from these indications, however, very little good can be accomplished, and much harm may be done, by the too energetic surgeon. But it must be remembered that these cases are not entirely hopeless, and the view obtained at operation only reveals the processes adopted by Nature in her endeavor to limit the progress of the disease, and it is probably due to this method of healing, and not to operative interference, that a number of surgeons have reported cures in the fibrous type of tuberculous peritonitis.

Primary tuberculosis of the peritoneum is extremely rare, as has already been mentioned. In not a few instances, however, the primary focus is located within the abdominal cavity, and this fact offers the best indication for operative measures, although it cannot always be determined before operating. Osler has estimated that the Fallopian tubes are involved in from 30 to 40 per cent. of cases. Mayo has reported 16 operations for tuberculous peritonitis, 11 of which were in women, with the primary focus in the tubes in 9, in the appendix in 1, while in the remaining case the focus was not discovered; in the 5 cases in men the focus was in the appendix and cecum in 3, and not found in 2. Krencki¹ reports a partial or complete removal of the adnexa in 9 of his cases, with 7 recoveries. Of the cases taken from the literature, simple laparotomy gave a percentage of cures in 66.17 per cent., while the removal of adnexa with laparotomy showed 76.6 per cent., or an increase of 10 per cent., in cures. Schauta claims that laparotomy is indicated only in those cases of tuberculosis of the peritoneum in which no tuberculous lesions exist in other organs, especially in the lungs.

Vierordt sees no contraindication in associated mild pulmonary tuberculosis, while Sick goes so far as to recommend laparotomy in coexisting pulmonary and lymphatic gland tuberculosis. Pribram does not consider a slight affection of the lung a contraindication. Schwartz contends that phthisis does not contraindicate laparotomy in peritoneal tuberculosis, as the respiration is improved by the lowering of the diaphragm. From this it would seem that only a very general hopeless phthisis would be a contraindication to operation. The advisability of operating in the presence of tuberculous enteritis is viewed differently by writers. Vierordt and Pic do not operate in this condition, while Israel, on the other hand, says that a simple laparotomy in this class may bring about a permanent cure. In general, it should be said that every means should be employed to choose the proper time for operating, and, as a rule, only afebrile cases should be chosen.

Technic of Operations.—The simplest surgical procedure that has been adopted in the handling of tuberculous peritonitis consists of opening the abdomen, removing any effusion that may be present, and closing the incision without drainage. In many instances, as in the unique experience of Sir Spencer Wells, this measure has been followed by permanent recovery. Of late, however, many operators have become skeptical as to the value of such a simple procedure, but many still speak for its advantages over treatment by paracentesis. Trans-abdominal

¹ Loc. cit.

laparotomy has always been the prevalent operation, although a few men, Condamin and others, have used the vaginal route in suitable cases.

This simple operation is modified in various ways. Most authorities advise against drainage, although it has been shown that the wound usually heals well and is rarely attacked by tuberculous processes. Others combine laparotomy with vaginal puncture. Many operators wash out the abdominal cavity with salt solution, or with mild antiseptic solutions of bichlorid, iodine, etc. Many dust iodoform lightly over the peritoneum. Strong antiseptics only do harm and should be condemned. The opinion of Lawson Tait is that drainage, irrigation, and medication of the abdominal cavity in these cases are not only useless but positively undesirable, and Treves has shown from the analysis of 300 cases that the best possible results are obtained when the abdominal cavity is neither flushed out nor drainage employed.

In the ulcerous form incision is made at the point where fluctuation is best obtained. Great care is to be exercised on account of the frequent adhesions of the parietal peritoneum to the omentum or intestines. The pus should be removed, but no attempt should be made to remove the false membranes which adhere to the peritoneum, nor to liberate the coils of intestines which may be agglutinated, as there is considerable risk of rupturing the coats of the intestines, which are extremely friable. Caseous glands may be removed and also any large caseous masses, provided it is possible to cut into healthy tissue. Special attention should be given to the condition of the appendix and tubes, as they can usually be readily removed if diseased.

In the fibrous form of tuberculosis of the peritoneum, the less done the better, and the only excuse to continue the operation when this form of peritonitis is found is for the purpose of relieving intestinal obstruction.

A review of the literature on the subject of the surgical treatment of tuberculous peritonitis shows, on the whole, a rather uniform mode of procedure, with here and there an individual variation. Shattuck¹ states that the procedure at the Massachusetts General Hospital consists in opening the abdomen, sponging and washing out the fluid with salt solution or plain water, and removing large masses of tuberculous tissue when found. The abdomen was closed in 32 cases, drained in 20. Forty-six cures are reported in these 52 cases.

Mayo² proceeded as follows: If the patient is a woman, the fluid is evacuated, the patient is then placed in the Trendelenburg position, and the general abdominal cavity is packed off in the usual manner. The pelvic organs, appendix, and cecum are now examined. If the Fallopian tubes, appendix, or cecum are diseased they are removed. The stumps and walls of tuberculous abscess cavities are dried and rubbed with sterile gauze and the abdomen is closed without drainage. Drainage sometimes leads to secondary mixed infection, with resulting fistulæ, which have a

¹ Loc. cit.

² Mayo, W. J.: "Surgical Tuberculosis in the Abdominal Cavity with Special Reference to Tuberculous Peritonitis," *Jour. Am. Med. Assoc.*, Chicago, 1905, xlv, 1157-1160.

decided tendency to become fecal. If the patient is a man, the incision is placed to the right of the median line, over the appendix. The fluid is evacuated, the appendix and cecum are examined, and, if conditions warrant, a radical operation is performed. If there are masses of fibrous tissue about the cecum, it is removed and the ends of the ileum and colon are closed by suture and a lateral ileocolostomy is performed. In some cases greatly enlarged tuberculous lymph-glands exist in the mesentery. As many of these as possible are removed.

Neff¹ states that a simple laparotomy, made rapidly but with great care, on account of the liability of intestinal and other adhesions, without irrigation or medication of the abdominal cavity, promises the best result. It may be necessary to drain in some cases. Hydrops should be evacuated when present. When there is an encysted mass, the adhesions should be separated and the cavity sponged out, provided it will not cause too much tearing and bleeding. He calls attention to the fact that the mortality is less than 3 per cent.; that marked improvement occurs in about 80 per cent. and that a permanent cure is effected in about 50 per cent. of all cases operated on.

Ochsner² states that a review of the literature has convinced him that surgeons who insist upon thoroughness in these operations had most unsatisfactory results. In his experience recovery has been somewhat more rapid and permanent in cases in which a glass drainage-tube, covered with iodoform gauze, was inserted into the cul-de-sac of Douglas and withdrawn as soon as it ceased to drain. He warns against intra-abdominal manipulations, especially of the infected intestines, but believes that the diseased pelvic organs—uterus, ovaries, and tubes—can be handled with less harm.

Giuldjides³ operates as follows: An incision is made in most instances in the median line below the umbilicus. It may be made parallel with the median line through the left rectus muscle (v. Winckel). Only a few authors recommend *cœliotomia vaginalis* (Condamin, Löhlein). The fluid exudate is carefully removed with sponges. Irrigations with antiseptic solutions are not used, except in the suppurative form of tuberculous peritonitis, in which case a mild agent is used, as boracic or salicylic acid, weak carbolic acid, thymol, weak zinc chlorid solution, iodoform, or only sterile physiologic salt solution. The resection of separate organs is recommended only in circumscribed, diseased, easily extirpated parts. Marguerucci recommends the loosening of adhesions only when such a procedure is necessary, as in occlusion of the intestine, pain, etc. Others advise the excision of the primary lesion wherever possible (Löhlien, Vierordt, Fehling, de Quervain). Drainage is unnecessary, as a rule, and is best omitted, as it may lead to stubborn fistulæ.

Bottomley⁴ finds that incision into the peritoneal cavity, evacuation of the fluid,

¹ Neff, Wallace: "Résumé of the Latest Literature on Tuberculosis of the Peritoneum," *Tr. South. Surg. and Gynec. Assoc.*, Phila., 1901, xiii, 377-386.

² Ochsner, A. J.: "The Toilet of the Peritoneum in Tuberculous Peritonitis," *Ann. Gynec. and Pediat.*, Boston, 1903, xvi, 507-509.

³ Loc. cit.

⁴ Loc. cit.

and closure of the wound, give as good results as the more extensive procedures. He does not believe that the tubes and ovaries should be removed in every case in which they are affected, and he believes that the diseased process in these organs, as well as in the indurated omental masses, may resolve spontaneously when left *in situ* after the more simple operation.

Medicinal Treatment.—The hygienic conditions surrounding the patient with tuberculosis of the peritoneum should be of the very best, and this applies, of course, to those treated surgically as well as to those not submitted to operation. The rigid enforcement of the principles of treating tuberculosis in general applies equally to this disease of the peritoneal membranes. The *sine qua non* is the combination of good food and fresh air.

Teleky,¹ writing in 1899, summed up the whole question as to the value of the internal or non-operative handling of tuberculous peritonitis. There is no specific with which to treat this affection as yet, although considerable importance may attach to the very recent work in the opsonic factors. The local remedies consist of hot applications and counter-irritation. For the intestinal troubles, pain, etc., enemata are given and small doses of opium are indicated. Byford² feels that there is some value in the use of intestinal antiseptics. The place of tonics, as the syrup of the iodid of iron, cod-liver oil, arsenic, etc., is recognized. The three essentials, however, are absolute rest in bed, abundant fresh air, and hyperalimentation. Spontaneous healing has been shown to take place in a sufficient number of instances to induce us to apply in every case of tuberculous peritonitis, whether on the medical or surgical side, the ideal conditions to favor such an outcome. As regards the use of drugs, the most important item is to see that nothing is prescribed that can in any way upset the stomach, for as long as the appetite and digestion remain unimpaired, so does the prognosis hold good.

For additional information the reader is referred to Chapter XVI, page 623, Vol. I, and to Chapter XXV, page 552, Vol. II.

The treatment of tuberculosis by means of specific products of the tubercle bacillus has been a subject of much investigation since 1890, when Koch first introduced tuberculin as a curative agent. The results in general have been disappointing, although of late interest has been revived in all forms of serum-therapy through the impetus given by Wright and Douglas in their investigations concerning the opsonic factors in the blood-serum.

Many physicians have continued to make use of tuberculin preparations since the early 90's in conjunction with the dietetic, hygienic, climatic, and proper symptomatic treatment of tuberculosis. Among these is von Ruck, in Asheville, who feels that they have added greatly to his results both in numbers improved and apparently cured, as well as to the permanence of results after discharge. In a

¹ Loc. cit.

² Byford, Henry T.: "The Intestinal Treatment of Tuberculous Peritonitis," *Ann. Surg.*, Phila., 1899, xxx, 253-259.

recent report¹ von Ruck gives 59.6 per cent. of apparent recoveries in a series of two hundred and sixty-one cases of pulmonary tuberculosis treated by the combined method, and quotes extensively from the literature as to the good results obtained from the employment of tuberculin as a curative agent. In this same report he cites a very interesting case of peritoneal tuberculosis in which a test dose of 0.5 mg. of tuberculin was administered, followed by marked general and local symptoms, and a speedy and permanent recovery. Von Ruck² has treated, in all, four cases of tuberculous peritonitis by specific treatment, with three recoveries dating back two, three, and six years, respectively. The fourth case was not influenced by the treatment, as the patient was in an advanced stage of phthisis, and the injections were given but a short time. In all of his cases local reaction to the tubercle bacillus extract was manifest following minute doses, and consisted of general diffuse tenderness and local pain in the abdomen. He is inclined to believe that the explanation for the effect of the tuberculin is similar to that given for the action of laparotomy in tuberculous peritonitis by Nassauer, who, on reopening the abdomen three hours after operation, observed a hyperemia of a degree which he says cannot be appreciated unless actually seen.

Recoveries from tuberculous peritonitis following the therapeutic use of tuberculin have been reported by Riegel;³ Kümmel,⁴ in a case in which two previous laparotomies had failed; Comes,⁵ cure confirmed by autopsy; Leser;⁶ Conitzer,⁷ three cases in children; Rumpf;⁸ McCall;⁹ Aufrecht;¹⁰ and Gray.¹¹

From a conflicting mass of case reports it is most difficult to draw distinct conclusions as to the relative values of the different methods proposed for the cure of tuberculosis of the peritoneum. In general, it may be said that in an affection of this kind one's first efforts should be directed toward treating the patient, while the second consideration has to do with the most approved method of handling the local process. Whether this is to be done surgically, symptomatically, or specifically will depend, for the present, very largely on the attitude of the physician in charge.

¹ Von Ruck, Karl and Silvio: "A Clinical Study of Two Hundred and Sixty-one Cases of Pulmonary Tuberculosis," etc. Asheville, N. C., 1905, 51.

² Personal communication.

³ Riegel, F.: "Bericht ueber die mit dem Koch'schen Mittel gemachten Erfahrungen," Deutsche med. Wochenschr., Leipz. u. Berl., 1891, xvii, 409-412.

⁴ Kümmel: "Beobachtungen mit dem Koch'schen Heilmittel," Ibid., 1891, xvii, 691-692.

⁵ Comes: Inaug. Diss., Bonn, 1891.

⁶ Leser, E.: "Ueber die Erfolge der Tuberculinbehandlung bei Chirurgischer Tuberculose der Kinder," Münch. med. Wochenschr., Dec., 1891, xxxviii, 835, p. 834.

⁷ Conitzer: "Zur Laparotomie der Bauchfelltuberkulose der Kinder," Deutsche med. Wochenschr., Leipz. u. Berl., xix, 1283.

⁸ Rumpf: "Zwei Fälle von Peritonitis tuberculosa," Deutsche med. Wochenschr., Leipz. u. Berl., 1896, xxii, Vereins-Beilage, 51-52.

⁹ McCall, Anderson: "A Case of Tubercular Peritonitis treated with Tuberculin," Scott. Med. and Surg. Jour., Edinb., 1904, xv, 520.

¹⁰ Aufrecht: "Erfolgreiche Anwendung des Tuberculins bei fiebernden Phthisikern," Deutsche med. Wochenschr., Leipz. u. Berl., 1905, xxxi, 1741.

¹¹ Gray, H. M. W.: "Vaccine Treatment in Surgery," Lancet, Lond., 1906, i, 1099-1103.

CHAPTER XXXIX.
PENETRATING WOUNDS OF THE ABDOMEN.
BY FLOYD W. McRAE, M.D.

Historical.—The history of the advance made in the treatment of penetrating wounds of the abdomen is practically the history of abdominal surgery. Penetrating wounds have always been regarded as of great import, and, as in the case of other accidents attended with a high mortality, the best method of treatment has been and is now a subject of discussion. Among the older medical writers there were two schools, at variance with one another regarding the proper treatment of penetrating wounds of the abdomen. The one advocated palliative treatment, in that the parietal wound should be kept open, various applications made, and large doses of opium administered; the other, realizing the frightful mortality attending such a course, advocated bolder measures—enterorrhaphy, cleansing of the peritoneal cavity, etc. While the advocates of the latter practice were quite few, it is interesting to review the opinions of some of them.

In 1606 Fallopius¹ favored enlargement of the external wound in order to expose intestinal lesions and to practise enterorrhaphy.

In 1759 Heister² stated that he saw no objection to the enlargement of the parietal wound, since upon the neglect of it certain death would follow. It appears, however, that little attention was given this teaching until 1836, when Baudens³ reported two cases operated on in 1831. Of these, one recovered. He advised enlargement of the parietal wound, exploration of the peritoneal cavity, repair of lesions, and the execution of suitable measures, *e. g.*, enterorrhaphy.

Pirogoff⁴ in 1849 operated for two shot perforations of the ileum. He considers this procedure the "only possible resource in such injuries." Lohmeyer,⁵ in case peritonitis was set up by the escape of the intestinal contents, advised probing of the wound, closure of the perforation, removal of the fecal material, and approximation of the abdominal wound.

Legouest,⁶ in the year 1863, wrote: "In lesions of the intestine by cutting weapons attended by the extravasation of solid or liquid contents, and in shot wounds, it is then proper to enlarge the external wound with the bistoury, to draw the gut outward and to close the solution of continuity by suture."

¹ Quoted by Otis in "Medical and Surgical History of the War of the Rebellion," Part Second, Surgical Vol., page 63, note 2.

² Laurentius: "A System of Surgery," 7th edition, chap. vii, p. 75.

³ Baudens: "Clinique des plaies d'armes à feu," 1836, p. 322.

⁴ Pirogoff, Nikolas: "Rap. méd. d'un voyag. au Cauc.," 1849; "Grundzüge," u. s. w., 1864, 578.

⁵ Lohmeyer: "Die Shusswunden und ihre Behandlung," Göttingen, 1859, S. 161.

⁶ Legouest, V. A. L.: "Traité de Chirurgie d'Armée," vol. x, p. 385.

Demme¹ said that on account of the element of uncertainty in penetrating wounds, he did not advise the further opening of the wound and a search for the wounded intestine. When the conditions were exceptionally clear he thought the procedure rational.

Hamilton,² in 1865, said: "Be assured the patient will have a better chance for life if we let him entirely alone—and it surprises us that any good surgeon should think otherwise."

Gross,³ in 1872, said that the enlargement of the parietal wound and the seeking for wounded intestine was not the proper thing in gunshot wounds; he restricted such procedures to stab wounds.

Erichsen,⁴ in 1873, said that operative measures were not called for unless the wounded gut protruded or fecal material escaped into the peritoneal cavity.

Billings, McGuire, Hewit, and Lincoln⁵ advised opening the abdomen and making a careful search for the wounded intestine.

The real advocate, however, of exploratory laparotomy for penetrating abdominal wounds, and the one who first insisted strenuously on its employment and its necessity in these cases, was J. Marion Sims.⁶ He said: "Given a case of penetrating abdominal wound, one should open the abdomen promptly, clean out the peritoneal cavity, search for the wounded intestine, pare its edges and bring them together with sutures; and then treat the case as we now treat other cases involving the peritoneum. Rest assured that the day will soon come when an accurate diagnosis in such cases, followed by prompt action, will save life that otherwise must quickly ebb away."

Kinloch,⁷ in 1882, was the first to publish a distinctly exploratory laparotomy for gunshot wound. In 1883 Kocher⁸ had a successful case. In 1885 Bull⁹ reported a successful case of laparotomy for gunshot wound before the New York Medical Society. From this time on, it is interesting to note that the number of laparotomies has steadily increased, and Morton¹⁰ in 1890 was able to collect ninety-four cases operated on by sixty-eight American surgeons.

Diagnosis.—The diagnosis of penetration of the abdomen, in civil practice, cannot be made with even approximate accuracy without laying open the wound. Attempts to follow wounds with the finger or the probe frequently eventuate in

¹ Demme, Herrman: "Militär-chirurgische Studien in dem italienischen Lazarethen," 1861.

² Hamilton, F. H.: "A Practical Treatise on Military Surgery and Hygiene," p. 354.

³ Gross, Samuel D.: "A System of Surgery," ii, 614.

⁴ Erichsen, J.: "The Science and Art of Surgery."

⁵ "Med. and Surg. Hist. War Rebellion," Part Second, Surgical Vol., p. 126.

⁶ Sims, J. Marion: "Remarks on the Treatment of Gunshot-wounds of the Abdomen in Relation to Modern Peritoneal Surgery," Brit. Med. Jour., 1881, ii, 925.

⁷ Kinloch, R. A.: "Gunshot Wound of Abdomen, Treated by Opening Cavity and Suturing Intestine," North Carolina Med. Jour., 1882, July, page 1.

⁸ Kocher Theodor: "Gunshot Wound of the Stomach: Successful Laparotomy," Brit. Med. Jour., 1884, ii, 78.

⁹ Bull, W. T.: "A Case of Gunshot Wound of Intestine Treated Successfully by Laparotomy with Suture of the Intestines," New York Med. Jour., 1885, xli, p. 184.

¹⁰ Morton, T. S. K.: "Abdominal Section for Traumatism, with Tables of Cases," Jour. Amer. Med. Assoc., 1890, i.

failure—neither confirming nor disproving penetration. These are dangerous expedients—universally condemned by the best authorities.

According to the most reliable statistics recorded, in only 10 per cent. of the cases of penetrating abdominal wounds do the hollow and solid viscera escape serious injury. There is but one positive sign of intestinal perforation—seen exceptionally—the escape of gas or feces externally. Shock is a very variable symptom, marked in nervous individuals, often practically absent in men of great fortitude in spite of grave lesions. When pronounced and persistent, it is strong presumptive evidence of free bleeding. Nausea, vomiting, and muscular tension are signs of value. The vomitus should be examined for blood. Blood in the stools is rarely observed early enough to be of diagnostic value as indicating perforation of an intestine. The Senn hydrogen gas test has proved unreliable and dangerous; it is conclusive, not exclusive.

Treatment.—In civil life, with fair hospital facilities, aseptic technic, and a competent surgeon available, almost every penetrating wound of the abdomen that does not prove immediately fatal on account of shock and hemorrhage should be dealt with by means of prompt operation. When everything is ready, the preparation of the patient should be made on the operating table during the administration of the anesthetic; the stomach should be washed out, and the field of operation thoroughly prepared. If there is any doubt that the wound is penetrating, it should be traced. By tracing is meant laying open the wound of entrance, the wound of exit, and the intervening tract of the bullet. Any one, or all three, may be necessary to prove or disprove penetration of the peritoneal cavity beyond doubt.

If the wound is penetrating, the operation should be so extended as to constitute an exploratory celiotomy; and if visceral damage is found, immediate repair should be made. Unless very unsuitably located, the wound of entrance should be enlarged enough for a thorough exploration. When this is not advisable, a median incision, either above or below the umbilicus, should be made. The location of the incision should be determined by the history of the case, the position of the patient when hit by the bullet, the angle from which it was fired, and its probable course.

On opening the abdomen the escape of any gas or feces should be noted and immediate search be made for the bleeding vessel or vessels, if there is profuse hemorrhage. Free bleeding should be arrested at once, and if essential to its accomplishment the incision should be enlarged and the patient partially or completely eviscerated. These extreme measures should be avoided if possible. Long incisions, evisceration, undue exposure of intestines, and rough handling greatly increase the operative mortality.

The first part of the intestine encountered should be brought out of the wound and a tape or a strip of gauze thrown round it by pushing one end through the mesentery, between vessels, with a hemostat. The ends of the tape or gauze are caught and held by forceps; and a cross-nick is made either above or below to give a definite point of departure. This is a little procedure of great practical value, requiring only a few seconds of time for its accomplishment. To look for the ileo-

cecal junction or some other readily recognizable portion of the intestinal tract is a waste of time, and the additional handling tends to spread infection in the presence of perforation with leakage. The whole intestinal tract should be rapidly examined, first above and next below the gauze. Slits in the mesentery should be repaired, bleeding arrested, and intestinal perforations closed as found. When it can be done without too much contracture of the lumen of the gut, perforations on the convex surface should be closed in its longitudinal axis. Perforations near the mesenteric border usually can be closed best transversely. Less obstruction is offered to the fecal flow by a longitudinal seam than by a transverse one, and the dangers from leakage and obstruction are consequently diminished. Care should be taken to see that the mesenteric vessels supplying the intestine are not interfered with. When the margins of the perforation are ragged and contused, they should be trimmed off. When the wound is small and clean-cut, interrupted Lembert sutures are all that is necessary. When the perforation is long and ragged, a few interrupted Czerny sutures should be inserted; over these Lembert sutures of celluloid linen (Pagenstecher) or silk should be placed to close the perforation accurately—care being taken not to infold too much tissue. The intestine in gunshot perforation is often in a state of spasmodic contraction. I have found this condition present in some part of the alimentary canal in almost every case of gunshot wound that has come under my observation. This contraction, reducing the gut much below its normal caliber, enhances the danger of infolding too much tissue, the bite of the suture being six to eight times deeper than it would have been had the gut retained its normal degree of distention and relaxation.

When there is considerable separation of the gut from its mesentery, resection and end-to-end anastomosis should be done. It is frequently a question of judgment as to whether a large number of perforations, close together, should be sutured separately, or a resection of that part of the intestine be resorted to. The latter is generally considered to be the better procedure, taking less time and diminishing the danger of obstruction. When a resection is done the intestine should be cut across obliquely, so as to be sure that the mesenteric border is a little longer than the convex border. The anastomosis can best be accomplished by continuous Czerny-Lembert sutures of Pagenstecher or silk, the mesenteric borders first being approximated accurately by the Maunsell mattress-mesenteric suture. The approximation of the cut ends is facilitated by interrupted sutures dividing the intestines into thirds, as suggested by Connell. Where haste is essential, the Murphy button may be used instead of sutures. For a detailed description of intestinal repair, anastomoses, etc., the reader is referred to Chapter XXXIV, Vol. II.

The intestine should be cleansed by moist sponging as the operation proceeds. If it is necessary to keep any considerable part of the gut outside of the abdominal cavity for a length of time, it should be covered by pads or towels wrung out of warm normal salt solution, and it should be kept moist and warm by frequently wetting the gauze with warm salt solution. This should be done by the assistant or the nurse. Under ordinary conditions, only a small part of the intestine need be

withdrawn from the abdomen at a time; as the surgeon draws out and traces the intestine his assistant follows after and replaces it in the abdominal cavity. After examining from the point of departure upward to the end of the gut above or below as the case may be, the part of the intestine on the other side of the gauze is drawn out by the strip of gauze around it and followed in the same way as above described, dealing with each injury seriatim. The strip of gauze around the intestine is next removed and the wound in the mesentery closed.

Careful handling of the intestine, without undue exposure, is essential in order to secure good results. Evisceration, rough handling, and a long exposure of the intestine have turned the scales in many of these abdominal injuries, and led to a fatal result.

Many of the deaths occurring seven to ten days after operations done for penetrating wounds of the abdomen are due to perforation caused by sloughing of the intestine, owing to separation from its mesentery. It must ever be borne in mind that a gut separated from its mesenteric blood-supply cannot live.

Note should always be taken of the presence of urine in the peritoneal cavity, and the bladder should be examined for injury. If the bladder has been perforated, it should be sutured accurately by interrupted sutures of catgut which embrace all the coats down to the mucous membrane. If the suture line cannot be tested by distending the bladder, a catheter should be introduced or drainage be obtained through a perineal incision. I prefer continuous catheterization through the urethra to making a perineal section. In these days of clean surgery and skilful nursing one need have little apprehension that the catheter, when properly handled, will cause chills or produce urethral irritation.

In one of my cases the bladder was tunneled for two inches, but other than the time required in making the repair it did not seem to complicate matters in the least. Two of the fatal cases in the Grady Hospital statistics quoted below were due to failure to find and properly deal with bladder injuries.

Injuries to the solid viscera other than the kidney and pancreas are dangerous chiefly on account of hemorrhage.

Bleeding from the liver can usually be controlled by light gauze packing. Where this does not suffice, deep through-and-through heavy catgut sutures loosely tied, or the tape suture of Tiffany, may be necessary. Strips of gauze packed in or about bleeding points in the solid viscera should be brought out through the abdominal wound for drainage. Injury to the spleen or its vessels causing free bleeding which cannot be controlled readily by packing or suture is an indication for splenectomy. Temporizing with such a condition is unwarranted. It is a serious complication, but by no means an absolute barrier to recovery. The immediate and remote results following splenectomy for injury have been remarkably good.

Injuries to the pancreas are very difficult to handle properly and consequently they are peculiarly fatal. When the pancreas has been injured the wound in it should be packed and both anterior and posterior drainage should be made (through-and-through drainage). (See Chapter XXXVI.)

Superficial injuries to the cortical substance of the kidney should be drained through the loin. It is dangerous to attempt to drain a kidney transperitoneally. When there is extensive laceration of the kidney substance, and when the renal vessels are severed, a nephrectomy should be done. Temporizing with a kidney thus injured will usually lead to a fatal result. [It has been advised to remove the kidney when its pelvis is torn. As a rule, it is proper to suture the pelvis with chromic catgut and to drain through the loin. A secondary nephrectomy may be required.—ED.] An essential to success in the treatment of penetrating wounds of the abdomen is a proper peritoneal toilet. The extensive washings out formerly advocated are now no longer sanctioned by good practice except in the presence of excessive soiling with intestinal contents, or in cases of very general or universal peritonitis. Better results follow careful local toilet, wiping infected areas carefully with moist sponges, than can be obtained by attempts at washing out the entire peritoneal cavity. Such attempts at washing out tend to spread what might otherwise be a local infection to widely separated dependent portions of the peritoneal cavity and to convert a local into a general infection. When a large quantity of water is introduced into the abdominal cavity the intestines are often forced out through the incision and can be replaced only with considerable difficulty and trauma.

The question of drainage must be determined by the conditions obtaining in individual cases. When the perforations are small, the intestinal tract comparatively empty, the closures accurately done, with little handling and soiling of the peritoneum, I close without drainage. When there are bleeding vessels that cannot be tied accurately, when there is extensive soiling of the peritoneum, and widespread peritonitis exists, it is safer to place one or more cigarette gauze drains.

It is a good rule to look for an even number of perforations.

Of first importance in the after-treatment of penetrating wounds of the abdomen is rest, general and alimentary. When the injury is in the upper part of the intestinal tract nothing should be allowed by the mouth except sterile water for several days. The lower bowel should be kept unloaded by simple enemata and rectal feeding should be employed. Purgatives must be avoided. A little morphin or codein may be necessary to relieve great pain and to secure proper rest. Opiates, however, ought to be given very guardedly. Strychnin is usually indicated. When there has been considerable hemorrhage, if practicable, a quantity of normal salt solution should be left in the abdomen. Normal salt solution should be given by hypodermoclysis or by intravenous transfusion as indicated. When there has been excessive hemorrhage, lives may often be saved by the free use of normal salt solution. In the presence of injury to the large bowel it is best to give simple sterile food by the mouth, that is readily absorbable from the stomach, and to introduce nothing into the bowel *per anum* lest the wound in the large bowel be forced open.

In the after-treatment of these cases, when there is marked gaseous distention, with a tendency to intestinal paresis, alum enemata, as first suggested by the late Virgil O. Haddon, of Atlanta, are of great value. Sulphate or salicylate of eserin in dose of one one-hundredth of a grain, every three to six hours, has seemed to

have a salutary effect. I absolutely exclude milk and egg diet by the mouth for the first five to eight days. Milk and eggs tend to increase the formation of gas and to constipate the bowels.

Purgatives should be employed with great care and only after four to six days following the operation.

Prognosis.—It is unfair to quote military statistics as an argument against operations in civil life. The conditions under which the injuries are received and the character of the injuries are so different as hardly to admit of just comparison. In modern military practice the abdominal injuries are due to small-caliber, steel-jacketed bullets of high velocity, which go directly through, making small, clean-cut perforations in the hollow as well as the solid viscera, from which there is very little leakage or hemorrhage. The injuries are more frequently than otherwise received in the standing posture, with a comparatively empty intestinal tract, by individuals in the prime of life—picked specimens of physical manhood. In civil practice the individuals are more frequently than otherwise shot in drunken brawls, when the alimentary canal is filled with alcohol and with all sorts of irritating and even infectious material. The wounds are made by infected bullets, which have been carried around in the hip pocket by “pistol toters,” of large caliber and low velocity, that make large, ragged perforations in the hollow viscera and jagged wounds in the mesentery and solid viscera that leak freely and bleed furiously. Other things being equal, the surgeon who opens the abdomen the earliest after the injury, does his work rapidly and accurately, and who closes the abdomen in the shortest time, will get the best results as to mortality.

The prognosis of penetrating gunshot wounds made by large-caliber, low-velocity bullets without operation, is bad. As shown by the accompanying statistics of the Crimean War, the American Civil War, and civil hospitals, about 90 per cent. prove fatal. Stab wounds and wounds made by small shot, or small-caliber, steel-jacketed, high-velocity bullets are less fatal, giving a mortality of from 50 to 75 per cent. Wounds of the umbilical and hypogastric regions are peculiarly dangerous. In these regions the small intestines rarely escape perforation.

PENETRATING ABDOMINAL WOUNDS.	NUMBER.	DEATHS.	MORTALITY.
Crimean War.....	241	222	92.1%
Italian War.....	246	163	87.2%
Civil War.....	3717	3031	87.2%
Franco-Prussian War.....	1047	784	74.8%
Spanish-American War.....	113	81	69.8%

Of the 113 cases in the Spanish-American War 13 cases had operations with 11 deaths—a mortality of 84.6 per cent. Of the 103 cases not operated upon, 70 died—a mortality of 67.9 per cent.

The contents of the stomach are comparatively innocuous. The virulence of the infection contained in the alimentary canal progressively increases to the ileo-

cecal junction; the contents of the large intestine are less infectious, and wounds of the large intestine are less often fatal, than are those of the small intestine.

PENETRATING ABDOMINAL WOUNDS.	OPERATION.	DEATHS.	MORTALITY.	NO OPERATION.	DEATHS.	MORTALITY.
Grady Hospital cases. . .	31	8	25.8%	16	10	62.5%
McRae's private cases. .	11	4	36.5%	5	4	80.0%

In looking over the statistics of the Grady Hospital, I find that there have been since July, 1899, forty-seven cases of penetrating wounds of the abdomen. Thirty-one of these were operated upon, with a mortality of 25.8 per cent. Sixteen were not operated upon, with a mortality of 62.5 per cent. Not a single death could have been attributed to the operation *per se*. In one fatal case a perforation of the gall-bladder was overlooked. In two fatal cases injuries to the urinary bladder were overlooked. In two cases the deaths were evidently due to kidney injuries, with leakage of urine into the peritoneal cavity, which were overlooked. In one case intestinal perforations were overlooked. In another case the abdomen was opened, found filled with blood, the blood washed out, and the abdomen closed, without finding the source of hemorrhage, the patient subsequently dying from internal hemorrhage.

These thirty-one operations have been done by eight different surgeons and three house surgeons (in turn); this large number of operators giving only a fair average of surgical skill. In spite of the fatalities due to overlooked injuries, the statistics following operations have been very gratifying and have constantly improved. The cases not operated upon were either very bad cases or those in which the wound was in such a locality as to indicate no injury to important viscera; for instance, well out in the lumbar region, high up in the hypochondriac region, or in the epigastric region. The cases operated upon have been worse as a class than those treated expectantly.

The contraindications to operation are bad surroundings, incompetent help, and the lapse of twelve hours or more between the receipt of the injury and possible surgical aid. Other things being equal, the mortality is in direct proportion to the length of time elapsing between the receipt of the injury and surgical intervention. After eighteen to twenty-four hours the mortality is so great that operation should be undertaken only when something positive can be accomplished by it. After this lapse of time, Nature has often done her best to repair the damage, and an operation increases the hazard.

My personal experience and responsibility cover but sixteen cases. I have, however, had intimate knowledge of most of the forty-seven Grady Hospital cases recorded below, and have assisted or been present at many of the operations done by other surgeons and have followed the cases in the wards. I have been forced by these observations and experience from an attitude favoring expectant treatment to a position of earnest advocacy of early operation, in all penetrating wounds of the

abdomen, unless positively contraindicated by the individual's physical condition and surroundings, or by the absence of a competent abdominal surgeon and assistants.

Of my sixteen cases, eight had the benefit of early operation, with seven recoveries. The percentage of recoveries was 87.5.

Six of the eight operations were for rifle or pistol-shot wounds, and all presented grave visceral lesions. One had an extensive laceration of the liver, with excessive hemorrhage, the patient exsanguinated and pulseless at wrist—recovery. One had three perforations in stomach with leakage—recovery. Four had multiple perforations in the small intestines with leakage in all—three recoveries, one death. In one of the above the bladder was also injured—recovery.

Two operations were done for stab wounds of the liver. Free hemorrhage in both cases was controlled by suture of the liver wounds and gauze packing—both recovered.

I have treated four pistol-shot wounds of the abdomen expectantly, with three deaths and one recovery. One man with a stab wound treated expectantly died. This makes five cases treated expectantly, with four deaths and one recovery—80 per cent. mortality.

I have done two late operations for complications due to penetrating wounds that might have been prevented by early operation. Both died—mortality 100 per cent.

The above statistics, my personal experience, observation of our Grady Hospital cases, and a careful review of the literature on penetrating wounds of the abdomen, abstracted below, have led me to make the following conclusions as to civil practice:

1. In civil practice every suspected penetrating wound of the abdomen, under favorable conditions, should have the benefit of wound tracing.
2. When the wound proves to be penetrating, an exploratory laparotomy should be done at once and visceral damage excluded or repaired as far as practicable.
3. There is far less danger from "wound tracing" than there is from probing or from "masterly inactivity," while awaiting positive evidence of visceral damage which requires operative interference.
4. Local toilet with moist sponging for cleansing is better than free peritoneal irrigation.
5. When in doubt it is safer to drain.
6. Operations done within two hours should not give a mortality over 25 to 30 per cent., within four hours over 40 per cent., within six hours over 50 per cent., within eight hours over 60 per cent., and within twelve hours over 70 per cent.
7. After twelve hours expectant treatment is best unless there is some definite indication for operation.

The above deductions do not apply to military practice. Expectant treatment in military practice has given better results with wounds made by modern arms than has operative treatment.

It does seem, however, that a mortality of 75 per cent. in military practice under

the expectant plan of treatment is too great, and ought to be reduced in future warfare by thorough organization and equipment of the medical department, prompt ambulance service, aseptic first aid, well appointed field hospitals in charge of competent abdominal surgeons and nurses, and a proper selection of cases for expectant treatment and for laparotomy.

ABSTRACT OF THE LITERATURE OF PENETRATING WOUNDS OF THE ABDOMEN.

The following abstracts give the history of the development of the modern treatment of penetrating wounds of the abdomen, and in addition give a clearer insight into the actual basis of the present teachings upon this subject than can be afforded by a summary statement such as has been made in the preceding pages.

Sims¹ said: "Given a case of perforation of the intestine in such a man as Gen. McClellan; and given a correct diagnosis, which is by no means difficult; what are we to do in the present state of our knowledge? Why, of course, we should open the abdomen promptly, clean out the peritoneal cavity, search for the perforation, pare its edges, and bring them together with sutures; and treat the case as we now treat other cases involving the peritoneum.² Rest assured that the day will come, and it is not far off, when an accurate diagnosis in such cases, followed by prompt action, will save life that otherwise must quickly ebb away, and the same thing must be done in gunshot wounds of the abdomen.

"Death from wounds of the abdomen may occur from shock, from hemorrhage, or from septicemia; seldom from peritonitis, properly speaking. When from shock or hemorrhage, there is no reaction and death is comparatively sudden. Reaction once established, shock is over and direct danger from hemorrhage is past. The great danger is from septicemia from effusion into the peritoneum. Some years ago it was thought that peritonitis was the chief cause of death after ovariectomy. But this is not the accepted doctrine of today. Death in these cases is due to septicemia and not peritonitis, septicemia caused by bloody serous fluids in the pelvic cavity.

"Why should not other wounds of the abdomen cause death in the same way as those made by the ovariectomy? I was convinced that we should find the same appearance in shot and other wounds of the abdomen that we found in fatal cases of ovariectomy."

Sims related two cases of gunshot wounds of the abdomen, both resulting in death, one case living five days, the other eighteen hours. At the autopsy in both cases there was an effusion of bloody serous fluid into the peritoneal cavity. The sudden outpouring of flatus into the abdominal cavity and extravasated fluids even in small quantities is sufficient for a septicemia. He said: "It is not the quantity, but the quality, of the exudate that kills. There is no reason why the system should not be overwhelmed by the absorption of concentrated septic material as by an overdose of morphin.

¹ Sims, J. M.: Brit. Med. Jour., 1881, ii, 925.

² Loc. cit., p. 3.

"It is necessary to reopen the abdomen after ovariectomy and allow the bloody serous fluid to escape, and it is necessary to open the abdomen and allow the escape of pus when peritonitis exists. It is possible that the escape of flatus and contents of the intestine into the bloody fluid gives an intensity to the poisonous qualities that it would not otherwise have."

In 1872 Sims said: "The danger consists not in opening the abdominal cavity, but in keeping it closed, and the day will come when gunshot and other wounds of the abdomen and perforations of the intestine will be treated by opening the peritoneal cavity, and washing out or drainage of the septic fluids."

"Do men ever recover spontaneously from gunshot wounds of the abdomen perforating the peritoneal cavity? Rarely indeed, if the bowel be wounded above the brim of the pelvis." At Sedan seven cases of shot wounds of the abdomen occurred, and they all died, most of them within twenty-four hours. There were several cases of recovery where balls passed through the pelvis, wounding the bladder or bowel, or both, but no recovery where the wound was above the brim of the pelvis. Of seven shot through the pelvis, all recovered.

"Why do patients shot through the pelvis live and those through the abdomen die? In the first case there is natural drainage of septic matter directly from the pelvic cavity along the track of the ball, and the patient lives. In the other case, drainage is impossible, because the septic matter falls into the pelvic cavity, is there retained and then absorbed, and the patient dies of blood poisoning. Occasionally wounds of the abdomen recover, but it is always when there is a chance for drainage."

Wounds of the Stomach.—There were 64 shot wounds of the stomach complicated with wounds of neighboring parts, with but one well-authenticated case of recovery. Of nine cases of bayonet wounds penetrating the peritoneal cavity without visceral lesion, six terminated favorably; seven of them had traumatic peritonitis. The diagnosis was not clear in all cases. There were four fatal puncture wounds of the stomach. Five men having fatal shot wounds are reported as having survived respectively seven, eight, nine, and forty days. There was not a single gastrorrhaphy during the war. Three men with secondary gastric fistulæ lived respectively four weeks, seven weeks, and eighty days. Otis sums up his conclusions concerning wounds of the stomach in the following words: There were four fatal punctured or incised wounds; one incontestable recovery from a shot perforation; a few recoveries from shot wounds in the gastric region in which the diagnosis was not determined unequivocally; and nearly sixty fatal cases of more or less complicated shot wounds of stomach.

The records of military surgery (according to Otis), from its earliest period to the present time, furnish but six or seven well-authenticated cases of recovery from shot wounds of the stomach, with or without fistula.

Wounds of Small Intestine.—"Of about 650 cases of penetrating wounds of the abdomen during the war, fifty were of the small intestine; 89 of large intestine, and over 500 in which the location of the wound was not discriminated, or was

complicated with other lesions." Wounds of the small intestine are more frequent and are attended with a higher mortality. Otis says that "it may still be doubtful if an incontestable instance of recovery was observed."

Wounds of Large Intestine.—Injuries of this group are less fatal than wounds of the small intestine; four instances are recorded of recovery from shot wounds of the transverse colon; many after perforation of the cecum and ascending portion of bowel; and a still larger number after wounds of the sigmoid and contiguous parts. Nearly all resulted in fecal fistulæ, eventually closing. The fistulæ persisted in nine and closed in fifty. Ten per cent. of those slain in battle die of wounds of the abdomen.

Wounds of Bladder.—There is no recorded case of punctured wound of the bladder in the Civil War. Of 183 shot wounds, 87 survived. Many of those surviving suffered from grave disabilities, *c. g.*, urinary fistulæ. It is rare to find functions of the bladder entirely restored after shot injuries. There were 21 cystotomies for removal of foreign bodies. Cystorrhaphy was not practised.

Shot Wounds of Rectum.—There are 103 cases reported, of which 44 resulted fatally. Thirty-four of the cases, of which four died, were complicated with wounds of the bladder. Fecal fistulæ were not uncommon. Shot wounds of the rectum are not so dangerous as those of the upper bowel.

Gastrorrhaphy.—Few recoveries followed punctured wounds; none followed shot wounds.

Enterorrhaphy.—Otis says there were 32 American instances of enterorrhaphy of the small intestine, of which 25 were successful. In all of them the bowel had prolapsed through punctured or incised wounds, and was sutured, and returned to the peritoneal cavity. They occurred between 1807 and 1869. Many cases are recorded where the prolapsed bowel was sutured and returned to the abdomen, yet the patients died—death being due to other perforations. Penetrating wounds are generally multiple and "show the absolute necessity of enlarging external wounds sufficiently for exploration." The records of the Civil War teem with reports of shot wounds of the intestines in which the victim lived for days, and finally died of exhaustion and blood-poisoning.

Senn¹ says: "Clinical experience and the result of experiment show conclusively that laparotomy should not be performed simply because a bullet has entered the abdominal cavity, but that its performance should be limited to the treatment of intra-abdominal lesions, which, without operative interference, would tend to destroy life. A bullet passing through the lower abdomen is always sure to cause some perforation, while if it enters antero-posteriorly at or a little above the umbilicus, it may be inferred with some degree of probability that there is an absence of severe visceral complication."

Klemm² gives an able digest of the literature as well as his results when working

¹ Senn, Nicholas: "The Modern Treatment of Gunshot Wounds in Military Practice," *Jour. Amer. Med. Assoc.*, July 9, 1898, xxxi.

² Klemm, Paul: "Gunshot Abdominal Wounds—Experimental Results," *Volkman's Sammlung klinischer Vorträge*, 1896, No. 142.

experimentally with dogs. He says: Few laparotomies were performed for gunshot wounds until after the American Civil War. German and American surgeons advise laparotomy for these cases, while the French, championed by Reclus, say that the expectant method gives a smaller mortality, arguing that during an injury to a hollow viscus a plug of mucous membrane protrudes through the wound and closes it. Klemm showed experimentally that such a plug could be and was produced, but it by no means closed the wound in the intestine nor successfully prevented leakage. In the majority of gunshot wounds of the abdomen, various viscera are injured.

Lühe observed 152 cases clinically, and only in three was there no injury; in 110 cases these perforations were multiple. The size of the wound in the gut is determined by: (1) The angle at which the bullet strikes it; (2) the diameter at the point struck.

He advises immediate operation in all cases in which the patient's condition will permit.

When peritonitis already exists or when a patient is weakened by a complication such as septic intoxication, operation is contraindicated.

Parker¹ divides the cases, as they present themselves, into three classes, the early, the intermediate, and the late—the early being seen not more than seven hours after injury, the intermediate between seven and fourteen, the late after fourteen hours. He believes that a penetrating wound of the abdomen is best treated by operation, before symptoms develop.

He gives a series of tables and a summary of thirteen cases personally observed and operated upon, with seven deaths—a mortality of 54.6 per cent.

Two cases with wounds of large intestine.....	both died.
Eight " " " " " small "	four "
Two " " " " " stomach	one "
One case with no visceral injury.....	recovered.

He then reports the collected results of 145 cases operated upon with a mortality of 53.1 per cent.

Of these cases:

41 cases wounds of small intestine within seven hours.....	51.2% mortality.
22 cases after fourteen hours.....	81.8% "
10 cases wounds of large intestine within seven hours.....	20 % "
2 cases after fourteen hours.....	100 % "
11 cases wounds of stomach within seven hours.....	27.2% "
5 cases after fourteen hours.....	80 % "
13 cases bowel resected within seven hours after injury.....	86.8% "

Grant² says that for all practical purposes the intestines, in penetrating wounds of the abdomen, will be injured in 73.2 per cent. of cases; the solid viscera or intestines, in 99.8 per cent. He advises immediate operation. The ordinary symptoms

¹ Parker, W. E.: "Gunshot Wounds of Abdomen," Southern Surg. and Gyn. Transact., 1896, ix, 272.

² Grant, H. H.: "The Practical Management of Bullet Wounds of the Abdominal Viscera," Southern Surg. and Gyn. Transact., 1898, xi, 39.

of perforation should not be waited for. Shock, pallor, vomiting, and severe pain may all be absent.

He reports four personal cases operated on within seven hours with one death. In the fatal case the intestines were greatly distended with fecal material.

Two other cases are reported: One wound of stomach and a large tear of the duodenum; one perforating wound of stomach, with liver wounded, and three wounds of intestine sutured—recovered.

Total, six cases—one death—16 $\frac{2}{3}$ per cent. mortality.

Winslow¹ says: As a rule the traumatism from a gunshot wound is greater than from a cutting wound and the mortality is higher.

Symptoms.—The most obvious symptom is the location of the wound of entrance. The presence of a gunshot wound of the anterior abdominal wall is enough to demand exploration, and if penetrating, laparotomy should at once be performed.

Prognosis.—The symptoms depend upon the nature of the traumatism, the organs and tissues injured, the degree of emptiness or fullness of hollow viscera when injured, and upon the presence or absence of serious hemorrhage. Gunshot wounds of the intestine in civil practice are usually fatal if not operated upon. In the Civil War gunshot wounds of both intestines had a mortality of 80.3 per cent., while the same injuries of the small intestine had a mortality of 100 per cent.

In recent military practice the prognosis and treatment are modified because of the small caliber of the projectile, with steel or nickel jacket, and of the greater velocity with which it is propelled by the modern rifle. The long narrow bullet, projected with great speed, penetrates the tissues cleanly, does not become deflected, and is usually aseptic.

In civil practice the bullets are generally large, the velocity is low, and the laceration more extensive. Penetrating, stab, and gunshot wounds occurring in civil life should be operated upon at once.

Total cases, 29	
5, no operation; 4 died.....	80 %
25 operated upon, 9 died.....	37.5 %
4 stab wounds operated upon, 4 recovered.....	100 %

Rodman² divides gunshot wounds into penetrating and perforating wounds. Of the penetrating wounds a vast majority are perforating—at least 97 per cent., according to Douglas. Penetration without perforation, even with large balls, does occur, as such cases have been reported by Senn, Stimson, Oliver, McGuire, and others. Wounds above the umbilicus are less likely to be perforating.

Sir Fred. Treves, Sir Wm. MacCormack, and other British surgeons, as a result of experience in South Africa, and Senn, Parker, Nancrede, and LaGarde, all saw penetrating wounds, which apparently were perforating, recover. At least 91 per cent. of penetrating wounds are perforating; 65 per cent. injure the intestine.

¹ Winslow, R.: "Penetrating Wounds of the Abdomen," Jour. Amer. Med. Assoc., 1905, xlv, 1048.

² Rodman, W. L.: "Gunshot Wounds of the Thorax and Abdomen from the Viewpoint of a Civil Surgeon," Jour. Amer. Med. Assoc., 1902, xl, 415-425.

The prognosis is always grave. Wounds of the liver, colon, and rectum are not as fatal as wounds of the small intestine. The prognosis is better in wounds above the umbilicus than in those below. Antero-posterior wounds are less dangerous than oblique ones; those from flank to flank are most serious.

On penetrating wounds of the abdomen Seigel's statistics show that of 537 cases not subjected to operation 55.2 per cent. were fatal; of 763 cases subjected to laparotomy 51.6 per cent. were fatal. Douglas' more recent statistics, compiled from the literature since 1895, record 65 cases, of which 44 recovered and 21 died—a mortality of 32.3 per cent.

Seigel's statistics show:

Operation, first	4 hours.....	15.2% mortality.
"	5 to 8 "	44.4% "
"	9 to 12 "	63.6% "
"	after 12 "	70 % "

Brown¹ says: The question to determine is not when to operate, but how and by what surgical methods we can best meet the indications of such cases.

He reports 9 cases of wounds of the intestine, of which 4 died, 3 were in a critical condition at the time of operation, and 1 died of pneumonia thirteen days after operation.

There were:

5 cases of wounds of liver: 4 recovered, 1 died.
 8 cases operated upon: no wounds of viscera found, all recovered.
 23 cases operated upon: 19 recovered, 4 died..... 17.4% mortality.

Brennfleck² gives a general review of splenectomies for injuries and reports a case in which splenectomy was done for a gunshot wound of the abdomen injuring the spleen.

Blood examinations at various times showed no great variation from the normal.

He concludes from his case and the literature that removal of the injured spleen is an operation neither dangerous to life nor injurious to the organism.

DeWreden³ says: The small-caliber mantle bullets were intended to mercifully remove the greatest number of men possible, for a more or less considerable period of time, out of the ranks of combatants. The Russian-Japanese War has completely demonstrated the destructive character of these bullets, which tear and comminute and become deformed relative to the distance and quality of the obstacle they meet.

Wounds of the abdomen inflicted from a distance up to two hundred steps are absolutely mortal, on account of an explosive effect of the bullet distinctly expressed at such a distance on intestines, urinary passages, and parenchymatous organs. With the increase of distance, and subject to the degree of filling of the intestines

¹ Brown, J. Y.: "Penetrating and Perforating Gunshot and Stab Wounds of the Abdomen with the Report of Cases," Amer. Jour. Obstet., 1903, xlviii, 707.

² Brennfleck, Ludwig: "Bericht über Eine durch Shussverletzung bedingte Splenektomie," Münch. med. Wochenschr., 1903, p. 803.

³ DeWreden, Romanovitch: "A Consideration of the Gunshot Wounds Inflicted with the Japanese Small Calibre Bullets," Jour. Assoc. Med. Surg. U. S., 1906, xviii, 311

and bladder, the picture changes rapidly, and beginning at a distance of four hundred steps the explosive effect is hardly perceptible. The bullet perforates the stomach, intestines, and bladder in the shape of rapidly closing crevices. Neither falling out nor prolapsing of the membrane is observed; and a rapidly developing adhesive inflammation, when full rest is maintained, separates, in a few hours, the injured regions from the rest of the abdominal cavity.

Vaughn¹ reports a series of 14 cases suffering with gunshot wounds of the peritoneal cavity.

8 cases of wound of small intestine.
 6 " " large " "
 12 operated on in from one to twenty-eight hours after injury.
 1 " " late.
 1 not operated on.
 9 patients died---mortality 64%.

Of these, six died from hemorrhage, one from peritonitis, one from exhaustion, and one from shock.

The mortality of wounds inflicted by the small missile with great velocity is less than that of wounds inflicted by other and older types of firearms. Treves stated that only 40 per cent. of gunshot wounds of the abdomen in the Anglo-Boer War, not operated on, died; but it has been well said (Hildebrandt) that if those who died on the battlefield were included as well as those dying during transportation, the mortality would exceed 70 per cent.

That recovery from a perforation of the intestine can occur without operation is unquestionably true.

Borden² says that 50 per cent. or more of all gunshot wounds of the abdomen received in war penetrate the abdominal cavity. In comparing the number of cases of penetrating wounds in the American Civil War, where 45 per cent. were penetrating, with those of the Spanish-American War, where 63.9 per cent., and the Philippine Insurrection, where 64.4 per cent. were penetrating, it will be seen that the number of penetrating wounds of the abdomen has probably been increased by the use of the modern small-caliber bullets. That the number of penetrating wounds is increased is to be expected from the great penetrating power of the modern missile. It will be noted also that, while the cases of penetrating wounds are increased, the fatality has markedly decreased. In the case of the English troops in the Crimean War, 92 per cent. of penetrating wounds were fatal, and in the American Civil War 90 per cent. succumbed. It is stated in the "Medical and Surgical History of the War of the Rebellion" that not a single case of wound of the small intestine recovered, the fifty-nine recoveries reported being from wounds of the large intestine. In the Spanish-American War the mortality was 66.6 per cent., and in the Philippine Insurrection 66.4 per cent., a gain of a little over 20 per cent. compared with the American Civil War. So far as military surgery is concerned,

¹ Vaughn, G. T.: "Gunshot Wounds of the Abdomen: A Review of Fourteen Cases, with Remarks on the Mortality and Treatment," Jour. Assoc. of Mil. Surg. 1906, xix, 150.

² Borden, Major William C.: "American Practice of Surgery," Bryant and Buck, ii, 727-728.

it appears that practically all the saving of life has occurred in cases not operated on. Colonel Whitehead reports eight cases during the Tuah campaign. Of these, five were operated on and all died. The other three did not require operation and recovered.

In the Spanish-American War there were 44 penetrating wounds of the abdomen in the regular troops. Of these, 4 were operated upon and all died. In the 40 cases not operated upon, 25 died, a mortality of 62.5 per cent. In 1899 in the regular and volunteer troops, there were 60 cases; 10 were operated upon and 9 recovered. The statistics of the Anglo-Boer War and the Russo-Japanese War are yet unavailable, but the operative experience in these wars appears to have been about the same as that of the Spanish-American War: viz., that practically all of the cases of recovery were cases which did not come to operation. In civil life statistics relative to operative interference are somewhat more favorable. Oliver gives 22 cases operated upon; of these, 5 recovered and 17 died, or 22.8 per cent. of recoveries. The "Year Book of Surgery," 1901, gives 66 recoveries and 41 deaths in 107 cases operated on. The difference in the mortality in the operations in military and civil practice is sufficient to show that the ability to operate early with aseptic technic and adequate surgical appliances and assistance, in a large measure accounts for the better results obtained. In considering these results the element of time is of major importance. Coley gives a mortality, from cases operated upon in the first twelve hours, of 53.9 per cent.; after twelve hours, 77.3 per cent. The relatively greater number of recoveries in the first twelve hours clearly demonstrates the importance of early operation in these cases. The sooner an operation is done after the receipt of the injury, the less likelihood there is of extravasation of intestinal and stomach contents into the peritoneal cavity, with resulting infection and fatal peritonitis.

CHAPTER XL.

HERNIA.

BY GUY L. HUNNER, M.D.

Historical.—Operation for the cure of reducible hernia was performed in the days of the Romans by methods differing but slightly from those in use today. Celsus¹ in the first century advised an incision in the groin extending down to the hernia sac, exposure of the field of operation by means of retractors, and the freeing and excision of the sac, preserving the testicle. When a small portion of omentum was found in the sac, this was pushed back by means of the finger or a sound, while if a larger portion was present it was excised by means of caustics, or by means of the ligature and scissors, in which case the ends of the ligature were brought out of the wound. If the contents were entirely replaced the wound was closed by suture. Heliodorus² gave specific directions for differentiating the infundibuliform fascia (called by him the dartos) from the peritoneal covering of the sac, and for twisting and cutting off the sac.

After several centuries of oblivion the operation was revived in the middle of the seventh century by Paul of Ægina, who directed that the testicle be removed with the sac.

It is remarkable that with the evidence of surgical activity in the field of reducible hernia during the early centuries, we have no record of operations for strangulated hernia. Celsus mentions the subject only to sound a note of warning against the methods in use in his day. Not until the sixteenth century do we find records of operation for strangulated hernia, which up to that time had been treated only by taxis. The first names associated with the operation were not those of authoritative scholars, but of empiricists and stone-cutters. Florentinus Vallensis and Maupas were the first to operate successfully for strangulated hernia,³ while Pierre Franco,⁴ a stone and rupture cutter of Lausanne, seems to have been the first to comprehend the subject thoroughly; and he described both the extraperitoneal and intraperitoneal methods of operating. Evidences of Franco's genius as a surgeon are apparent in his directions to "make a generous opening into the peritoneum without fear," and to replace the slippery intestine with "a little piece of fine linen." He made use of the grooved director for guiding the knife when cutting the ring. In suitable cases and with the consent of the patient, after freeing the strangulation he proceeded with the radical cure of the hernia, "for, indeed, more than half of the necessary interference has been accomplished."

¹ Neuburger u. Pagel: "Handbuch der Geschichte der Medizin," 1905, Bd. iii, S. 261.

² Albert: "Lehrbuch der Chirurgie," Bd. iii, S. 282.

³ Neuburger u. Pagel: Loc. cit., S. 267.

⁴ Neuburger u. Pagel: Loc. cit., S. 267.

Sir Astley Cooper early in the past century made such exhaustive studies in the anatomy and pathology of hernia that there has been but little of importance added since his writings.

From the therapeutic standpoint success in the surgical treatment of hernia cannot be assured without aseptic methods, and for this reason the almost universal application of surgery to the cure of ruptures of all kinds has been a development of our own generation. In the evolution of the modern aseptic operation the names most familiar to the surgical world are those of Billroth in Austria, Czerny in Germany, Lucas Champonnière in France, Bassini in Italy, McEwen and Banks in Great Britain, and McBurney, Andrews, Ferguson, Bloodgood, and Halsted in America. Many other names from both continents could be added to this roll, names of surgeons who have not been in the main stream of controversy, but who have made substantial contributions toward the perfected methods of our day.

It is surprising that hernia literature so constantly overlooks the work of Henry O. Marcy, of Boston.¹ So far as I can learn, Marcy was the first surgeon of modern times deliberately to advise and undertake the radical cure of a reducible hernia. On February 4, 1878, he operated on a woman of seventy for a large, direct inguinal hernia, the patient having been successfully operated upon by Marcy two months previously for large strangulated hernia of the opposite side.²

His first radical cure of strangulated hernia was performed in 1871.³ Marcy credits his teacher, Lister, with having performed in 1869 the first recorded operation for strangulated hernia done under the new antiseptic method.

Marcy's free dissection and closure of the parts antedated the similar operation done by Czerny, of Heidelberg, in October, 1877, by six years.⁴ Czerny, however, resected the hernia sac at its base, while Marcy in his first operations returned the sac to the peritoneal cavity.

In his communication to the International Medical Congress held in London in 1881 he "emphasized the freeing of the sac and its resection, after sewing it across at its base with a continuous animal suture, and then refreshing the pillars of the ring, and closing by deep, buried, double, continuous sutures of kangaroo tendon, which are much to be preferred to catgut."

In May, 1886, at the annual meeting of the American Medical Association,⁵ Marcy reported a series of over thirty consecutive operations, showing that with proper antiseptic precautions the operation was without danger. He recommended the dissection of the sac at its base, its suture, and excision, the restoration of the obliquity of the canal, and closure of the parts with the buried tendon suture: "(1) In all cases of operation for strangulation. (2) In all cases where the abdominal contents are imperfectly retained by the truss, unless the age and the condition

¹ Marcy, Henry O.: "The Anatomy and Surgical Treatment of Hernia," 1892, New York.

² Marcy, Henry O.: *Trans. Am. Med. Assoc.*, 1878, vol. xxix, p. 295.

³ Marcy, Henry O.: *Boston Med. and Surg. Jour.*, 1871, vol. viii, p. 315.

⁴ Czerny: *Berlin. klin. Wochenschr.*, 1881, xviii, 45.

⁵ Marcy, Henry O.: *Jour. Am. Med. Assoc.*, 1887, viii, 589.

of the patient prevent. (3) In the large class of children, when the conditions do not promise a spontaneous cure."

Throughout his work this pioneer was a most ardent and consistent experimenter in search of a durable aseptic animal material that could be used as both ligature and suture. He advised joining like tissues, and suturing in layers, avoiding the leaving of dead spaces, and being equally careful not to constrict tissues. Drainage, in his opinion, was not only needless but a positive disadvantage and danger. In his last mentioned communication, however, he speaks of generally using a twisted horse-hair for drainage, and in his London report he says that drainage is used if the abdominal wall is thick.

Definition.—An abdominal hernia is an abnormal protrusion of the parietal peritoneum occupied temporarily or permanently by contents from the abdominal cavity. In exceptional cases, as in hernia of the retroperitoneal organs, the peritoneal sac may be absent or it may only partially inclose the contents, such as the ascending or descending colon or the bladder.

The coverings of a hernia differ greatly according to the location of the hernia and to the conditions of its origin and development. In the development of a hernia whatever tissues the sac pushes ahead of it become the coverings. These coverings, as well as the sac, are at times greatly altered by such forces as pressure, stretching, traumatic irritation, and inflammation.

Contents.—Practically every organ of the abdominal cavity has been found occupying a hernial sac. We naturally find most frequently these organs which are more movable, viz., omentum, small intestine, colon, and cecum. The cecum with the appendix have been found even in a left inguinal hernia. The longest mesentery is that supporting the ileum at a point about 25 cm. above the ileocecal valve, hence the predisposition of this portion of the bowel to become herniated.

Hernia of the Bladder.—This condition is rare. Coley¹ found no instance of bladder protrusion in 950 cases operated upon for inguinal and femoral hernia. This viscus is most often found in the direct inguinal hernia. In any inguinal, femoral, or low ventral hernia of long standing and large size the bladder should be kept in mind during operation. Hernia of the bladder may be developed during operation by traction on the hernia sac or contents. This is a special danger in operating upon children, and one must here watch for the prevesical fat and the peculiar retiform bladder musculature. In adults with long-standing bladder hernia the musculature of the bladder wall may be wanting, in which case the submucosa closely resembles a second hernia sac. A careful anamnesis in older children and adults will usually lead to a probable diagnosis which may be verified by simple methods of examination. The bladder is generally only partially prolapsed, its herniated portion being connected with the abdominal portion by an isthmus. The patient often passes urine in two stages, and sometimes learns to compress the hernia while voiding. The hernia is apt to be tender, and pressure over it causes a desire to urinate. The tumor decreases in size upon voiding, and a forced injection of water

¹ Coley: "Abdominal Hernia," Sultan, 1902, p. 42.

or air into the bladder causes the hernia to augment in size. Cystoscopic examination will make the diagnosis more certain. An interesting complication is the formation of a stone in the herniated portion of the bladder.

Hernia of the Female Genital Organs.—The ovaries have been found in inguinal, femoral, ventral, umbilical, obturator, and sciatic hernias. Both ovaries are at times



FIG. 783.—HERNIA OF THE PREGNANT UTERUS IN A NEGRESS (Kelly's "Operative Gynecology").

The uterus has escaped through a ventral hernia, due to a celiotomy, May 3, 1894, of which the scar is plainly seen. The patient went to term and was delivered of a living child by a normal labor. (A. R., Gyn. No. 1390, Dec. 3, 1895.)

found in bilateral hernias. A Fallopian tube may be the sole occupant of a hernia, but it is more often found in association with the ovary. The uterus may occupy a hernia, alone or with its adnexa, and in this position it may become pregnant (Fig. 783). R. Birnbaum¹ reports a case of inguinal hernia of the uterus and

¹ Birnbaum, R.: Berlin. klin. Wochenschr., 1905, vol. xlii, S. 632.

pregnancy. A pathologic condition not sufficiently recognized is the poor general tone of the muscles and tissues due to sedentary habits, to old age, or following illness, particularly gastro-enteritis in children. The frequency of hernia in multipara is referred to the repeated stretching and relaxation of the abdominal walls incident to pregnancy.

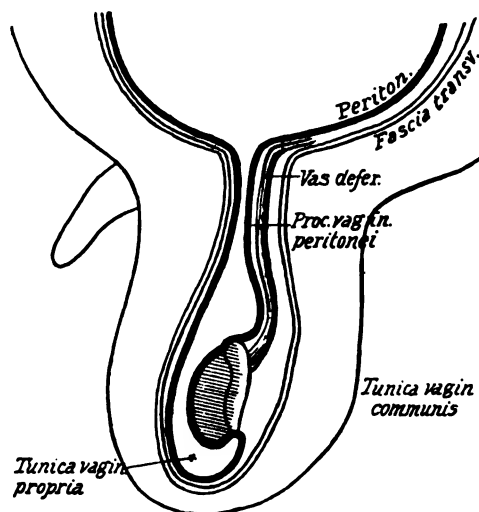


FIG. 786.—SHOWING DESCENT OF THE TESTICLE (Stieda-Pausch).

Position of the testicle in the ninth month of fetal life; origin of the vaginal process of the peritoneum which remains as the hernia sac in cases of congenital origin.

the hernia patient is subject may be mentioned inflammation, irreducibility, and strangulation.

Inflammation.—The anatomic conditions of most hernias are such as to favor inflammatory changes during some period of their history. The narrow neck and wider sac favor conditions of stasis and consequent inflammatory reaction in the sensitive peritoneum of both the sac and the abdominal contents. The superficial location exposes the sac and its contents to external violence, and the pressure of a truss may prove a source of irritation. Every grade of inflammation is possible. At times the process is so mild and chronic that the hernial contents become adherent without special symptoms, some hernias undergoing spontaneous cure through the process of chronic inflammation. The pres-

Diagnosis.—Generally speaking, the diagnosis of an abdominal hernia is not difficult, but there are cases in which a certain diagnosis cannot be made even with the most careful and systematic attention to all the signs and symptoms. The methods of establishing a diagnosis for all varieties of hernia will be discussed under the special section on inguinal hernia.

Accidents and Complications of Hernia.—Among the more common and dangerous complications to which

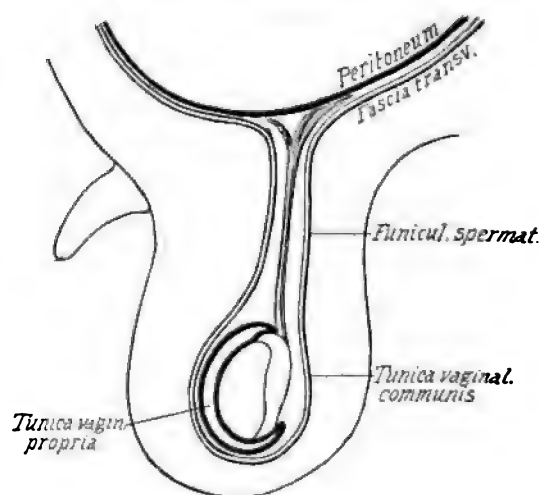


FIG. 787.—SHOWING DESCENT OF THE TESTICLE (Stieda-Pausch).
Position of the testicle at birth; origin of the tunica vaginalis propria.

ence of a truss probably acts favorably in some instances by holding back the abdominal contents and so irritating the neck of the sac as to excite a chronic inflammation which ultimately results in adhesions and occlusion. In other cases the omentum forms a plug which becomes adherent in and closes the neck of the sac. At times the inflammation occurs in mild acute attacks in which the patient suffers pain and tenderness in the hernia region. Such attacks may follow unusual exertion which brings about circulatory changes within the sac, or causes increased irritation by the truss; or they follow a kick or other external violence.

Irreducibility.—The mild acute attacks of inflammation usually subside without special treatment and with no discoverable gross changes in the hernia, but, as with the mild chronic inflammatory changes just mentioned, permanent adhesions may form and lead to the irreducibility of a formerly reducible hernia. Another condition preventing the reduction of hernial contents is a development of a disproportion between the neck of the sac and the volume of its contents. This factor is often dependent upon inflammation, which causes adhesions between the hernial contents and forms a mass too large to be returned. In such cases there may be no adhesions to the sac wall. The omentum is the organ which most frequently becomes irreducible. This may occur because of inflammatory adhesions binding it to the fundus or to the neck of the sac, or a disproportion may arise between the size of the hernial ring and the contained omentum. A section of omentum may occupy a hernial sac for years and be perfectly reducible, when a slight inflammatory swelling or other change causes the neck of the sac to become so small that the omentum cannot be replaced. The weight and dragging of the omentum may cause a dwindling of the portion in the neck of the sac. Any pressure at the hernial ring tends first to shut off the venous flow and cause an acute or chronic passive congestion, thus increasing the bulk of the hernial contents. The natural increase in size of the omentum incident to advanced life often interferes with its reduction. The similar increase in size of the epiploic appendages has been found to cause irreducibility in cases of hernia of the large bowel. Tumors of the mesentery have caused the same result. Hernia rarely become irreducible before adult life. The condition is said to be transitory, seldom lasting through an entire lifetime. For this reason Macready advised the application of pressure by means of a properly adjusted truss. Femoral hernias are more difficult of reduction than inguinal. Several years are sometimes required for the reduction by pressure. Too often the conditions of inflammation and irreducibility interact and cause strangulation.

Strangulation of a hernia is that condition which results when the compression in the hernial ring or at the mouth of the sac is such as to entrap the hernial contents and cause stasis of its circulation. The strangulation may be temporary and by proper measures quickly relieved. But if unheeded, the tendency is toward progressively serious and fatal results. The rapidity and seriousness of the process depend in a measure upon the hernial contents, but no rule can be formulated; for an intestinal strangulation may extend over a period of several days without serious injury to the

bowel, while an omental strangulation may rapidly lead to infarct, necrosis, infection, and death.

There are many theories as to the mechanism of strangulation. Referring the student to special works on hernia for these theories, we will speak of two generally accepted views as to the mode of origin.

Elastic Strangulation.—When from any cause a loop of intestine or other viscus is forced into the hernia sac and the momentarily dilated orifice resumes its usual dimensions, the hernial contents are subjected to pressure at the neck of the sac and strangulation follows.

Fecal Strangulation.—If from sudden augmentation of the intra-abdominal pressure or from other cause the fecal contents of the herniated loop of intestine be suddenly increased, there may result a disproportion between the neck of the sac and the hernial contents.

In either of the two modes the results are the same: there is unusual pressure at the neck of the sac. This may be so great as to cause complete stasis of circulation and anemic infarct of the hernial contents. Usually, however, there is at first venous stasis. This leads to increase in bulk of the hernial contents, transudation of serum, necrosis of the tissues, and, if the contents be intestine, perforation follows. Infection takes place probably through the general circulation if the incarceration be of the omentum, and through the intestinal walls if intestine be present. The inflammation now spreads to the surrounding tissues. The phlegmon may rupture externally, in which case spontaneous cure may result if only the omentum be present, or a fecal fistula may follow intestinal necrosis. If the inflammation extends to the abdominal cavity, septic peritonitis and death is the usual result.

Symptoms and Course of Intestinal Strangulation.—The most common symptom of intestinal strangulation is pain. The patient is usually able to state just the time of onset and its immediate cause, usually a hearty laugh, a cough, or some unusual violent muscular effort. There is at first a sharp pain in the region of the hernia orifice, and the patient finds a swelling for the first time, or he is unable to return a formerly reducible hernia. Nausea, eructation, and vomiting quickly supervene, and the vomited material comes successively from the stomach and the intestines, finally becoming fecal if the obstruction be low in the tract. Twisting or griping pain from the peristalsis causes great restlessness and agitation. Neither feces nor gas are passed by the rectum, although enemata may wash out some fecal material located below the constriction. Too much dependence, however, should not be placed upon the bowel symptoms. At times there is nausea without vomiting. And again cathartics and enemata may bring away considerable fecal material. The local inflammation may result in a diarrhea and passage of large quantities of mucus and feces.

Locally the hernia, which is at first soft, soon becomes tense and extremely painful on manipulation. Edematous swelling of its contents, accumulation of fluid, both inside and without the affected loop, and the accumulation of gases

contribute to the hardness. The hernial swelling now becomes discolored and extremely sensitive to the touch. The external wall may perforate and give rise to a fecal fistula or anus preternaturalis. Or if the inflammation extends to the peritoneal surface, the patient rapidly becomes worse. The pain increases with the first wave of peritoneal infection, after which it may disappear. Nausea and vomiting often become worse, the patient is cyanotic, the pulse grows small and its rate increases, the temperature may rise or it may fall below normal, the tongue becomes coated and dry, the eyes retract, the nose is pointed, and a cold sweat covers the entire body. The urinary secretion is diminished and anuria may be the direct cause of death. Graser says that 95 per cent. of untreated strangulated intestinal hernias end in death. Berger¹ states that, per hundred cases, strangulation is about twice as frequent in the female as in the male. This is probably due to the preponderance of femoral hernias in the female and the greater liability of this form to strangulation. Strangulation is rare in children and treatment by taxis is usually successful.

Special mention must be made of strangulated hernia of the intestinal wall in which only a portion of an intestinal segment protrudes through the hernial neck (Fig. 788). The portion strangulated may pass through the same phases of degeneration as in the strangulation of an entire loop, and, like the latter, may end in



FIG. 788.—A STRANGULATED HERNIA OF THE INTESTINAL WALL (after Sultan).

Showing only moderate degree of tissue change.

external perforation and fecal fistula, or in general peritonitis. The symptoms are very similar: there is sudden severe pain with nausea and vomiting. The intestine may be open and respond to cathartics and enemata or there may be obstruction. Diarrhea may prevail. The physical signs often prove the physician's *bête noir*. If the sac contents consist only of the portion of intestinal wall, the hernia is of necessity very small. Careful examination should be made of the femoral and obturator regions, for it is here that this class of hernias occur most frequently. Tenderness and even redness may be found when no tumor is discoverable.

Rare Complications.—Among other unpleasant complications of hernia should be mentioned an inflammation of a *contained vermiform appendix*, in which the symptoms are likely to lead to a diagnosis of strangulated hernia. This condition occurs most frequently in children (21 per cent. in children under two years of age—Prüss²) and in the aged.

¹ Berger: "Résultats de l'examen de dix mille observations de hernies," etc., Paris, 1896.

² Prüss: Inaug. Dis. Halle-Wittenberg, 1902.

Tuberculosis of the hernia sac is rare. R. Lewisohn¹ reports fifty-eight cases from the literature and adds four cases of his own. It may arise in the sac or be secondary to a general peritoneal or miliary tuberculosis.

Carcinoma of the hernial contents has been described, and the following local signs may be very similar in the last two diseases: spontaneous pain, enlargement and hardening of the sac, dulling of the percussion note, fluid in the sac which may return to the abdominal cavity on pressure.

Certain complications are associated with treatment or operation for hernia.

Severe intestinal hemorrhage at times follows the reduction of a strangulated hernia, probably due to sloughing of the mucosa. Stricture following this same process not infrequently causes intestinal obstruction at a later period (Meyer²).

Inflammation of the omentum sometimes follows operation for strangulated hernia. Soon after the operation a hard abdominal tumor is palpated which may slowly disappear or eventually break down in suppuration.

Pneumonia is not an uncommon complication of hernia operation, particularly after operation upon strangulated hernia; and this accident seems to occur as frequently after operations under local anesthesia as after those for which general anesthesia has been used. This makes probable the generally accepted view that these pneumonias arise from the deposition in the lungs of infected thrombi from the mesentery of the strangulated gut.

Recurrence after operation will naturally depend somewhat upon the operator and upon the method employed; but with any of the better methods in use the after-results depend upon various important factors. The character of the tissues, whether flabby or of good tone, is a very important element in the final result. Per primam healing of the wound is important. Bloodgood³ shows that in Halsted's clinic there were but 3 per cent. of returns in hernia cases healing per primam, while in suppurating cases there were about 20 per cent. of returns.

GENERAL TREATMENT OF HERNIA.

We have stated that the most prolific hernia period is the first year of life; and the practitioner should remember that many hernias undergo spontaneous cure. The post-natal closure of the peritoneal diverticulum may be complete and result in permanent cure, or there may be simply a narrowing of the neck of the canal; and in after years, with favoring conditions, the hernia will again appear.

Treatment by Truss.—Under the section on Hernia Complications we have spoken of the value of the truss in some cases, and we drew attention to the fact that the danger of strangulation is not so great in children as in adults. By the use of a proper truss or bandage there is considerable chance for cure of an umbilical

¹ Lewisohn, R.: Mitteil. a. d. Grenzgeb. d. Med. u. Chir., 1903, Bd. xi, Heft 5, S. 657.

² Meyer: "Intestinal Stenosis after Operation or Non-operative Reposition of Incarcerated Hernia," Deutsche Zeitschr. f. Chir., Leipzig, 1905, lxxvi, S. 297.

³ Bloodgood: "Operations on 459 Cases of Hernia in the Johns Hopkins Hospital from June 1889, to January, 1899," Johns Hopkins Hosp. Rep., 1898, vii, p. 223.

is no tenderness, a truss, should be at once applied to prevent another descent and consequent strangulation. After a reduction by taxis the patient should be most carefully watched for at least forty-eight hours because of the serious dangers already mentioned. If taxis fails, or if for any reason taxis is contraindicated, operation should be performed at once.

The operative procedure for strangulated hernia may be simple—the cutting of the hernial ring, and the reduction of the contents with the application of a binder; or it may prove most difficult, requiring the exposure of the hernial sac, the freeing of many adhesions, and a resection of the bowel. Between the conditions calling for these two extremes of operative treatment is a wide range of possibilities, requiring the greatest exercise of surgical skill, and particularly of surgical judgment. The surgeon must determine from the history of the attack and from the macroscopic appearances the degree of tissue injury and the probabilities of their *restitutio ad integrum*. From the appearance of the sac contents, and possibly with microscopic aid, he must ascertain whether infection is present, estimate its degree and virulence, and decide whether the peritoneum and other tissues will successfully combat the condition. He must carefully weigh the signs and symptoms, compute the degree of shock already suffered, and have a fair idea of the patient's reserve powers.

If the patient is in good condition he may be given a bath and the usual skin preparation. If food has been taken recently, the stomach may be washed out with the tube before anesthesia. If there is any question about the heart or lung condition, or if there be marked shock, local infiltration anesthesia is preferable. Obese women with large ventral hernias are not infrequently the subjects of strangulation, and general anesthesia should never be risked in this class of cases because of the danger of fatty heart, strangulation from vomiting, and the more remote danger of pneumonia. The principal points of the operation are: (1) to cut down upon the sac; (2) to examine the contents; (3) to cut the neck of the sac; (4) to return the contents if their condition permits; (5) to perform a radical cure of the hernia. The radical cure should be attempted in but a limited number of cases—those, namely, which have had a thorough skin preparation and in which the changes in the sac contents do not jeopardize the healing of the wound. In exposing the sac the skin incision is carried well above the ring in order that the seat of constriction may be freely inspected. If the strangulation be of a large ventral hernia, great care must be exercised in making the skin incision, for the skin and subcutaneous tissues are greatly attenuated and an accident may easily befall the hernial contents. In any case, one must be cautious in opening the sac, although fluid is usually present and protects the bowel from injury. By inspection of the contents one determines the degree of injury and decides upon the best method of treatment. If the contained fluid be clear and odorless, the strangulated tissues are generally in a good state of nutrition, and even if the fluid be blood tinged and of slightly stale odor the contents may be but little changed. After carefully irrigating the sac contents with normal salt solution at the body temperature the next step is to divide the constricting ring. This is done by cutting from without inward with an ordinary knife, or from

within outward with a herniotome. In cutting for an inguinal hernia, one palpates for and attempts to avoid the deep epigastric artery. In femoral hernia the femoral vein and the deep epigastric and femoral arteries may almost completely surround the ring, hence it is best to cut down from without inward and be ready to clamp and tie any injured vessels. After the constriction is cut one draws gently on the contents to free the tissues in the neck and make sure that the circulation of the blood is re-established. By careful pressure the distended gut is emptied toward the efferent end. A moderately injured bowel should now be wrapped for several minutes in warm moist gauze, and if it regains evidences of a normal circulation it may be returned to the abdomen and the wound be closed. If, however, there be a question of infection of the sac contents, or if the bowel still seems cyanotic and paralyzed, it should not be returned without a generous surrounding with strips of iodoform gauze, the ends of which fill the abdominal wound.

If the hernial fluid is turbid or purulent and has a foul fecal odor, if the intestine shows extensive mural hemorrhage, if its surface has lost its moist glistening appearance, and if the bowel wall when pinched into a fold fails to show an elastic recovery of outline—in such conditions the surgeon's judgment is put to the greatest test. Such a case may be treated by bringing the affected loop out of the wound, wrapping it loosely in moist gauze, and leaving it. If the bowel recovers and the wound remains clean, the bowel may be returned in a few days and free drainage left down to its granulating surface. In cases of suspected gangrene Helferich recommends that a lateral anastomosis be made between the afferent and efferent portions, a hand's-breadth from the constriction bands, and that only the suspected loop be left in the wound. If it recovers, it may be returned later. If well-marked gangrene be present, a choice is presented between an intestinal resection with anastomosis (Barker¹) and the making of an artificial anus. Usually the patient is in extreme shock and the time element is an important factor in the operation. Heretofore the great objection to an artificial anus has been the fact that the patient's general nutrition suffers after the operation, particularly if the opening be high in the bowel. Now that we know that the bowel may be handled without giving a general anesthetic, the best results will probably be obtained by making an artificial anus under cocain anesthesia, and as soon as the patient has recovered from the primary shock, the gangrenous bowel can be anastomosed without giving the patient an anesthetic. This method has the added advantage that after a few hours the viable intestine can be selected with greater accuracy, for it is well known that the afferent bowel often breaks down above its ring of constriction.

INGUINAL HERNIA.

Inguinal hernia in men will be treated of in a special chapter in this work. This form of hernia is of far less importance in women. Not only are the hernias

¹ Barker, A. E.: "The Treatment of Gangrenous Hernia by Enterectomy," *Lancet*, London, 1903, i, pp. 1495 and 1576.

less frequent in women, but when present the anatomic conditions are so much simpler that the radical cure involves fewer surgical problems.

The conditions of embryonic development are such that a peritoneal protrusion is less likely to occur in this region in the female. In later life differences in occupation make the primary causes of hernia less frequent in the female, and the greatest factor in the relative frequency in the two sexes is probably found in the content of the inguinal canal. The small round ligament of the female does not compare in size with the large spermatic cord and its ever-changing blood-vessels.

In the female the inguinal hernia is generally external or oblique and follows the course of the round ligament. It may descend low enough to form the so-called labial hernia.

The persistent diverticulum of the peritoneum in the female or the canal of Nuck may predispose to a congenital hernia. Like the processus vaginalis of the male, this peritoneal tube may be constricted anywhere in its course and give rise to a hydrocele. It is usually impossible to differentiate a congenital from an acquired inguinal hernia in the female, but the presence of a hydrocele with a hernia is suggestive of a congenital hernial sac.

Diagnosis.—With the exception of a few peculiarities characteristic of each variety of hernia, the diagnosis of inguinal hernia is made on the presence of signs and symptoms common to all hernias. For these we depend upon the anamnesis and examination. The patient complains of pain, and of a swelling or tumor formation. Pain may be an unimportant symptom even with large hernias, or it may be severe, and appear before the swelling is discovered. It may be local, or reflected to the abdomen or back, or in inguinal hernia it may follow the distribution of the ilio-inguinal and genitocrural nerves. Associated with the pain, digestive disturbances with constipation and occasional nausea and vomiting are not uncommon symptoms. The patient can usually tell whether the tumor developed suddenly or gradually, whether it first appeared within the abdomen, or within the scrotum or labium, and whether it changes in size. Other important points to be gained from the patient's history have been mentioned under etiology.

The examination includes inspection, palpation, and percussion. Inspection reveals whether the swelling corresponds in position to one of the hernial orifices; whether its outline is abrupt, suggesting a tumor, or gradual, suggesting its close connection with the abdomen; whether it changes in size or disappears with a change in the patient's position; and whether there is an impulse on coughing. Intestinal peristalsis can sometimes be seen in large hernias. The character of the contents can often be determined by the aid of transmitted light. Palpation is even more helpful than inspection for determining whether the tumor has a pedicle connection with the abdominal contents. If the tumor can be replaced into the abdomen it is almost certainly a hernia, and its contents may at times be determined by palpation. If gurgling is felt and if the contents are reduced suddenly, intestine is present. If the contents go back slowly and noiselessly, omentum is present. Detection of impulse is a great aid in the diagnosis of hernia, but impulse is some-

times felt when a solid or cystic tumor lies upon or occupies the abdominal orifice. To determine impulse in the inguinal canal one places the index-finger on the front of the testicle and then pushes upward through the external ring invaginating the scrotum. In the female the internal ring is found through the skin of the labium by pushing this through the external ring. Intestinal gurgling may be best detected by aid of the stethoscope. Percussion generally, but not always, gives a tympanitic note if intestine be present in the tumor.

The formations most frequently mistaken for hernia are lipoma, hydrocele, enlarged glands, dislocated testicle, tumor of the testicle, fibroma of the round ligament, and psoas abscess. Subperitoneal lipoma of the inguinal region is rare and its diagnostic points will be mentioned in discussing hernia of the linea alba.

Hydrocele develops slowly and from without toward the abdomen, and, except in the very rare cases of persistent *processus vaginalis communicans*, cannot be reduced. It is connected to the abdominal cavity by the spermatic cord or round ligament only, and therefore appears more sharply circumscribed from the abdominal wall and can be moved about with greater freedom than in the case of hernia. Transmitted light shows the clear contents of hydrocele unless blood and pus are present.

Treatment of Inguinal Hernia.—The non-operative methods of treatment have been sufficiently discussed. The great development in the operative treatment of hernia during the past quarter century has centered about the problems concerning the cure of inguinal hernia. Some of the more important problems in controversy have been the methods of dealing with the peritoneal sac, the disposition of the cord with its component parts, the vas and the veins, the fate of the testicle, methods of autoplasty in the attempt to overcome defects in the abdominal wall, the suture material, and the questions of antisepsis, asepsis, and the healing of wounds.

Americans have had a prominent part in the evolution of the successful hernia operation, and we have seen that Marcy was its first advocate, his written reports antedating those of Bassini and Halsted by several years. His closure of the wound in separate layers has now been replaced by Andrews' imbrication method,¹ and his attempt to restore the obliquity of the canal by bringing the cord out of the upper end of the wound has been modified by some surgeons who prefer to leave the cord undisturbed, as was originally practised by Czerny. To Gerard belongs the credit for first advocating a return to the old method of treating the cord, and Bloodgood,² in reviewing the results obtained in Halsted's clinic, questioned the necessity of cord transplantation. The best disposition of the cord is still an open question. The chief value of the imbrication method undoubtedly lies in the fact that it compels a neat surgical dissection and frees the lower portion of the internal oblique muscle.

To Bull and Coley, of New York, belongs the credit of having popularized the Bassini operation in this country.

The operation for inguinal hernia in women is comparatively simple, particularly

¹ Andrews: Chicago Medical Recorder, Aug., 1895, vol. ix, p. 67.

² Bloodgood: Johns Hopkins Hosp. Rep., 1898, vii, p. 226.

to the surgeon who has mastered the principles of the operation on men, and for this reason the reader is referred to the chapter treating of inguinal hernia in men. The only special feature about the operation, as performed in women, is the presence of the round ligament. If the position of the uterus is normal this may be disregarded. If the uterus is retroverted and the pelvic organs free from disease, the round ligaments may be shortened and included in the sutures which fasten the internal oblique to Poupart's ligament, thus curing the displacement of the uterus as well as the hernia.

Local Anesthesia in Hernia Operations.—Mention has been made of the value of local anesthesia in hernia operations on the aged and on obese patients with strangulation. Other positive indications for the use of this method are certain bronchial, pulmonary, cardiovascular, and kidney affections. Cushing,¹ of Baltimore, has done valuable work on the anatomic and clinical features of nerve blocking in the inguinal region, and we quote freely from his instructions regarding inguinal hernia.

"Individuals advanced in years are usually kept in bed for a day or two preliminary to the operation, to give an indication of their ability to endure recumbency, and for the purpose of training them to void their urine in this position. Evacuation of the bladder is usually accomplished by the aid of an enema if any postural difficulty is experienced.

"It has been the custom to administer hypodermically a tenth or an eighth of a grain of morphin three-quarters of an hour before, and to repeat this shortly before the operation. The drug must be used with caution, however, since occasionally even small doses of morphin in old people may confine the bowels and lead to distention, which may be troublesome. Similarly, in old people with tardy bladders it may inhibit the proper evacuation of the urine, though we have never had the misfortune to observe this.

"Patients past middle age are usually shaved and prepared on the operating table, to avoid any exposure incidental to an open ward preparation. The skin in the line of proposed incision is infiltrated with Schleich's cocain solution, and the incision may be immediately made through the linear wheal thus produced (Fig. 789). It is common experience to find the infiltrated tissues more vascular than usual, and it is important that all bleeding points be immediately clamped, since a dry and unstained field is essential to the success of the dissection. It is unnecessary and useless to attempt to anesthetize the panniculus. As Schleich has shown, only tissues which can be 'edematized' are fitted for the infiltration method, and in the panniculus, at the upper angle, practically no nerves are encountered. If, however, throughout its whole length this incision is carried down to the aponeurosis, unanesthetized fibers of the iliohypogastric will be encountered in the superficial fat at the lower angle, together with one or two large veins, division of which is painful, so that anesthetization of the panniculus layer is here necessary, or else, as has been done on several occasions, the incision only at the upper angle may be

¹ Cushing: *Ann. of Surgery*, Jan., 1900, xxxi, p. 1.

carried down to the aponeurosis, which is then opened in the line of fibers from the external ring, and the iliohypogastric and inguinal nerves immediately cocainized with a 1 per cent. solution as they lie under it. After this procedure the lower angle of the incision may be painlessly carried down to the external ring, and the remaining intercolumnar fibers of the aponeurotic insertion then divided. There is, under ordinary circumstances, no further need of the anesthetic, as we are working in an

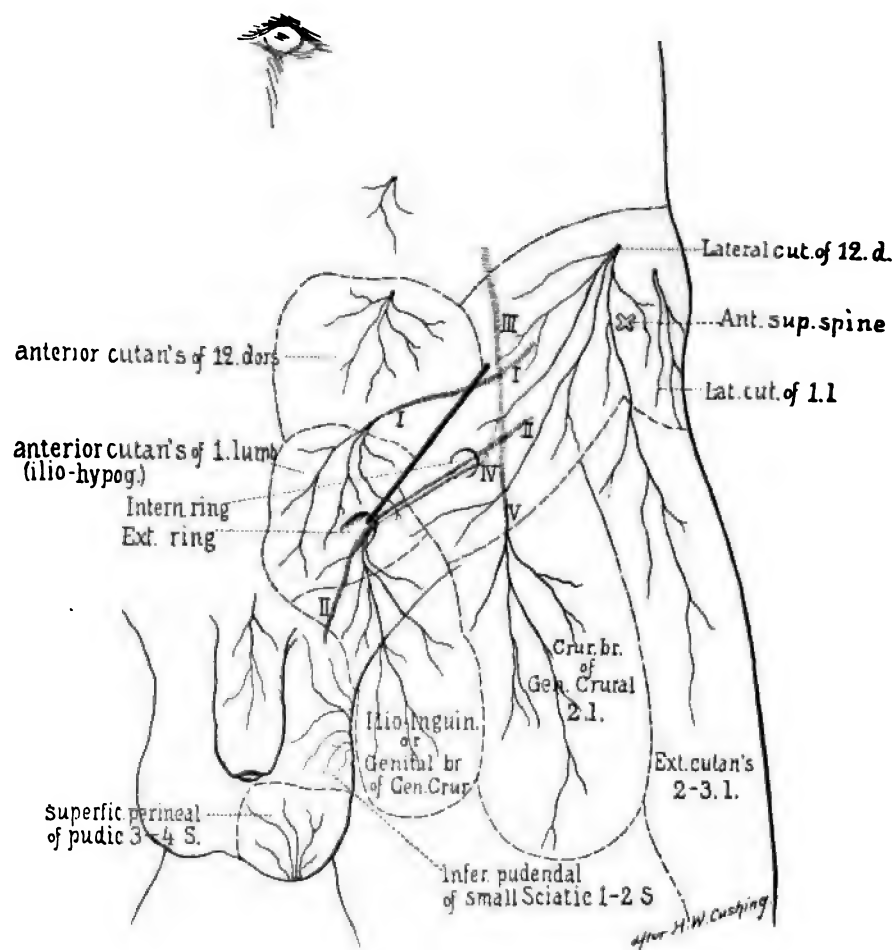


FIG. 789. —SITES FOR LOCAL ANESTHESIA IN THE INGUINAL REGION (after Cushing).

area freed from all sensation. The combined ilio-inguinal and genital branch, which has been cocainized at the outer limit of its exposure, is now reflected to one side or the other, care being taken not to divide it, since this leads apparently to a more or less permanent paralysis of the cremaster, which is to be avoided. I believe the accidental division of this nerve leads to the great relaxation of the scrotum so often seen after hernia and varicocele operations. In the latter operation, especially, it would be detrimental to the best interests of a successful result to interfere with

the cremasteric function in any way. The remainder of the operation—the exposure of the sac and cord after a longitudinal division of the infundibuliform fascia, the amputation of the sac at its neck, and closure of the peritoneal opening, the excision of the fundus of the sac, division of the cord, and castration, if deemed advisable—may now be done practically without pain. Occasionally, however, some stray fibers of the genitocrural may be encountered about the neck of the sac, and also during castration I have found that ligation of the veins at the lower pole of the testicle may be painful, though division of the cord above is not. Possibly the superficial perineal branches which have been unanesthetized furnish nerves to this lower blood-supply.”

A recent communication by J. A. Bodine,¹ of New York, reporting three hundred cases of inguinal hernia operated on under local anesthesia contains many practical suggestions and is worthy of careful study.

FEMORAL HERNIA.

Femoral hernia, while less frequent in women than the inguinal variety, is much more frequent in women than in men. It claims the especial attention of the abdominal surgeon today because of the less settled state of its therapeutics as compared with inguinal hernia.

According to Coley,² femoral hernia has a slightly higher mortality and a smaller percentage of permanent cures than inguinal.

Of one hundred women affected with hernia, 32.7 per cent. have femoral while 44.3 per cent. have inguinal hernia (Berger). Macready³ gives the proportion of inguinal to femoral in the female as 6 : 4. Pott⁴ collected a series of 15,028 operations for inguinal and femoral hernia, of which 14,092 were for inguinal and 933 for femoral, showing a proportion of fifteen inguinal to one femoral.

Coley, in doing one hundred and seventeen operations for femoral hernia in one hundred and five patients, found thirty-four of the operations in children between the ages of two and fourteen years, while eighty-three operations were done upon adults, or patients between fourteen and seventy years of age. The infrequency of occurrence in childhood is due, no doubt, to the fact that the femoral ring is small until its widening coincident with the growth of the pelvis at puberty. Coley's statistics show that in children the relative frequency of femoral hernia in males to females is one to two, while in adults it is about one to six.

Anatomy.—A reference to Figs. 790 and 791 recalls the anatomy of the femoral region. A femoral hernia has no preformed canal corresponding to the inguinal canal, but makes a path as it descends, pushing ahead of it or to one side the peritoneum, the so-called septum crurale of the transversalis fascia, the lymphatic glands, and the loose areolar tissues of the space through which it passes. As it leaves the

¹ Bodine, J. A.: Medical Record, 1905, lxviii, p. 645.

² Coley: "The Radical Cure of Femoral Hernia," Ann. of Surgery, 1906, xlv, 519.

³ Macready, Jonathan: "A Treatise on Ruptures," 1893, London.

⁴ Pott: Deutsche Zeitschr. f. Chir., 1903, lxx, S. 556.

abdominal cavity its sac passes through a ring formed by the fibrous covering of the femoral vein externally, the processes of transversalis and iliac fasciæ meeting over the outer edge of Gimbernat's ligament internally, Poupart's ligament anteriorly, and the iliac fascia lying over the pubic ramus posteriorly. The sac descends along the vein and pushes ahead of it the cribriform fascia of the saphenous opening. Its investing tissues are often so thinned that the sac is encountered immediately below the skin.

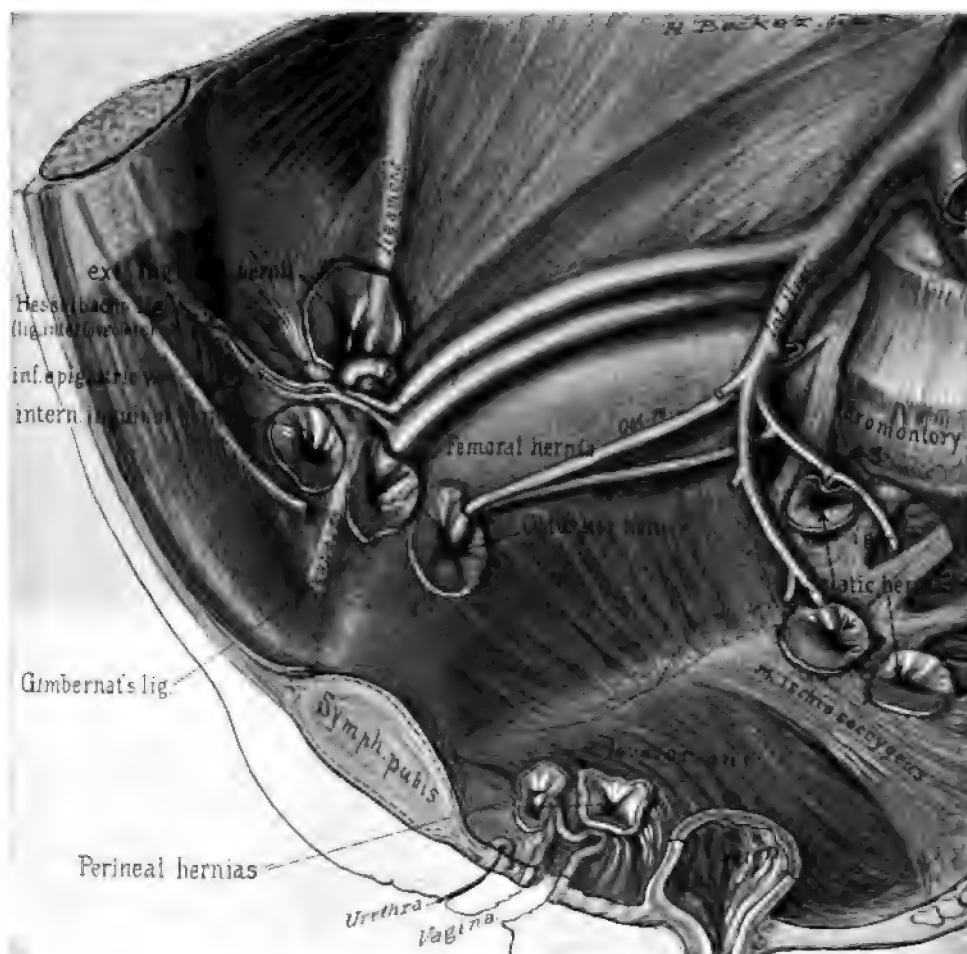


FIG. 790.—ANATOMY OF THE FEMORAL REGION.

Diagnosis.—The diagnosis of femoral hernia is generally not difficult if careful attention is given to the anamnesis and examination. In most femoral hernias inspection shows the protrusion to lie below Poupart's ligament, but there are cases in which femoral hernia develops upward in front of Poupart's ligament and in which the diagnosis is difficult even with the aid of palpation. To differentiate between femoral and inguinal hernia the neck of the sac must first be located and then

its position determined with reference to Poupart's ligament. This is sometimes difficult in obese individuals, particularly if the hernia be large, and the diagnosis becomes most difficult if the hernia is irreducible or strangulated. Subperitoneal lipoma is prone to occupy the femoral canal, and in this position may form a tumor which produces the symptoms and shows many signs characteristic of hernia. If a femoral hernia pushes between the septa of the cribriform fascia it may form a dense nodulated tumor mass which is irreducible and very difficult to differentiate from enlarged glands. Varicose veins of the femoral region occur, with enlarged veins elsewhere over the leg, and a thrill can be felt, and with the stethoscope a humming murmur heard over the varix. Cysts of the hernial sac may complicate the diagnosis.

Because of the firm character of its surrounding tissues the neck of a femoral hernia is particularly liable to constrict the sac and cause strangulation. This is usually of the elastic variety and is apt to be complete from the beginning; thus rendering taxis a procedure which in most cases is not only useless but positively dangerous. When bowel obstruction and other symptoms of hernia are present, the surgeon should always make a most careful examination of the femoral region, for lateral strangulation of the bowel wall is most frequently through this aperture, and nothing may be found but a very small tender swelling to the inner side of the femoral vessels.

Treatment of Femoral Hernia.—The truss treatment of femoral hernia is even less satisfactory than for the inguinal variety. In this region it is difficult to fit a truss that will not be displaced by the different movements of the hip-joint. The measurement for the steel band should be made in the circumference of the pelvis midway between the anterior superior spine and the great trochanter. While in inguinal hernia the pad lies parallel to Poupart's ligament, in femoral hernia it should be more vertical and usually of small size.

Operation.—In no better way can the unsettled state of the therapeutics of femoral hernia be illustrated than by making a comparison of two recent papers by recognized authorities.

Ochsner¹ advises the method originally advocated by Socin.² Acting on the well-known surgical principle "that it is practically impossible to keep a circular opening in any part of the body from closing spontaneously unless it be lined with a mucous or serous membrane," Ochsner advises the simple plan so long in vogue: viz., "to dissect out the hernial sac quite up into the peritoneal cavity beyond the inner surface of the femoral ring, ligate it high up, cut it off and permit the stump to withdraw within the peritoneal cavity. Removing all the fat contained in the femoral canal and simply closing the skin wound completes the operation for femoral hernia. This method is applicable to all simple femoral hernias in which an actual femoral ring exists."

Coley,³ on the other hand, says that in the earlier operation of simple excision

¹ Ochsner: "Femoral Herniotomy," Jour. Am. Med. Assoc., 1906, xlvii, 751.

² Socin: Langenbeck's Archiv, 1879, xxiv, S. 391.

³ Coley: Loc. cit.

of the sac without attempt to close the canal there was a recurrence within a year in 30 to 40 per cent. of the cases. He quotes Potts' statistics covering 933 cases of femoral hernia as showing 63.3 per cent. of cures when the sac was simply excised and the wound closed without suture of the canal, while there were 76.4 per cent. cured by the methods including canal closure.

Coley uses with slight modification the operation first described by Cushing, of Boston, and describes the operation as follows. (See Fig. 791.) "An oblique

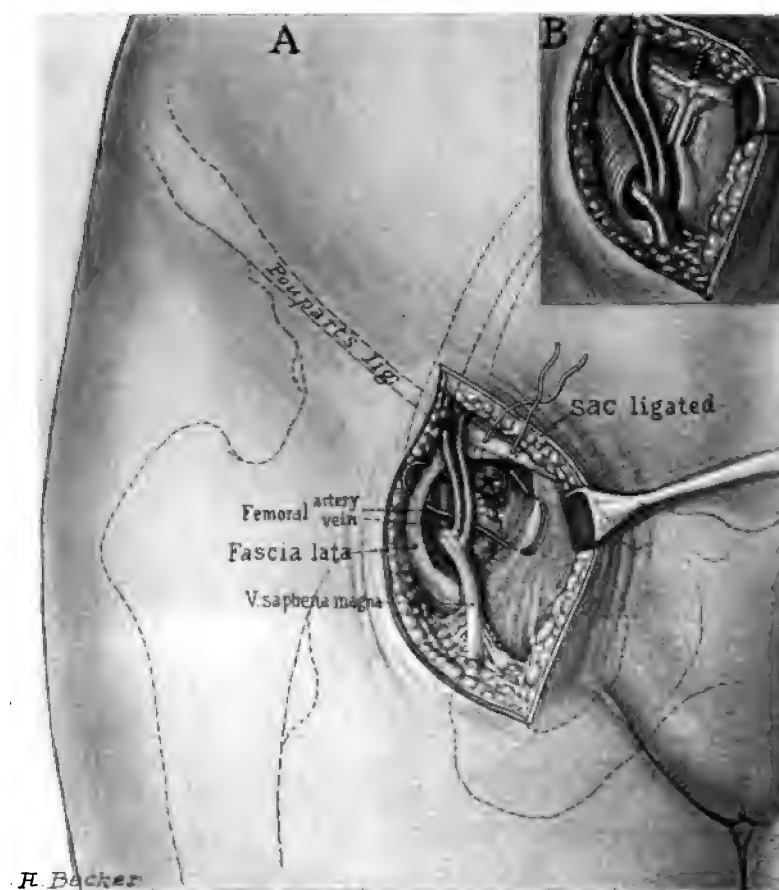


FIG. 791.—CUSHING'S OPERATION FOR THE RADICAL CURE OF FEMORAL HERNIA.

incision is made one-quarter to one-half inch below Poupart's ligament and parallel with it, almost identical with the incision made for inguinal hernia, only slightly lower and a little shorter. The sac with the mass of extraperitoneal fat that almost always surrounds it is then freed well up into the femoral opening. The masses of fat are carefully removed, the sac itself, by gentle traction, is brought down well beyond its neck to a point where it widens into the general peritoneal cavity. It is always opened before ligation, to make sure that it is empty. If omentum is present, this is tied off and removed. The ligature having been placed well beyond the neck

by transfixion, it is carefully tied and the sac removed. When the stump of the sac has been pushed through the opening into the abdominal cavity, there is no longer any funicular process present in the femoral region. With a curved Hagedorn needle, threaded with kangaroo tendon, of medium size, the suture is placed as follows: The needle is first passed through the inner portion of Poupart's ligament or the roof of the canal, then downward, taking firm hold of the pectineal fascia and muscle, then outward through the fascia lata overlying the femoral vein, and finally upward, emerging through the roof of the canal about one-quarter inch distant from the point of entrance. On tying this suture, the floor of the canal is brought into apposition with the roof, and the femoral opening is completely obliterated. The skin and superficial fascia are closed by means of an interrupted catgut suture and a sterile dressing is applied, without drainage. The first change of dressing is made at the end of one week. The patient is kept in bed for two weeks and allowed to go home at the end of two and a half weeks. A firm spica bandage is worn one week after leaving the hospital, at the end of which time no further support is needed."

To more effectually fill the femoral canal various plastic operations have been devised. Salzer¹ took a flap from the pectineal fascia, and, leaving its apex intact at the upper end, he transplanted the free lower end and sutured it to Poupart's ligament in such a way that the femoral canal was closed. Watson Cheyne² turns up a flap of the pectineus muscle and fascia. Moullin³ uses the pectineus and adductor longus. Schwartz⁴ uses the adductor longus, and Finney⁵ independently devised the same operation. Finney has returned to the purse-string operation, which he had used with satisfaction for many years.

Of the various heteroplastic methods, Trendelenburg⁶ reported at the Nineteenth Congress of the German Surgical Association the insertion of a bone plate to aid in filling the hernial ring, thus being the first to use a foreign body in the closure of a hernia. Later he turned down a pediculated periosteal bone flap chiseled from the pubic bone. Thiriar,⁷ of Brussels, sutures a decalcified bone plate over the femoral ring from within the abdomen. Roux, of Lausanne, drives a metal staple through Poupart's ligament into the pubic bone. The work of Witzel and of Goepel, in which they used permanent silver wire netting for the closure of large hernial apertures, will be spoken of under umbilical hernia.

Methods, such as that of Gordon,⁸ requiring the closure to be done from above Poupart's ligament, and of Lotheissen,⁹ who fastens the conjoined tendon to the pubic ramus, seem unnecessarily complicated, and must be less successful than the simpler methods except in the hands of surgeons of broad experience.

Noble (private communication) reports that since 1892 he has operated without

¹ Salzer: *Centralbl. f. Chir.*, 1892, xix, S. 665.

² Cheyne, Watson: *Lancet*, London, 1892, ii, 1039. ³ Moullin: *Lancet*, London, 1896, i, 479.

⁴ Schwartz: *Congrès de Chir.*, Proc. verb., Paris, 1893, vii, 689.

⁵ Finney: *Md. Med. Jour.*, 1899, xli, 151.

⁶ Trendelenburg: *Centralbl. f. Chir.*, 1890, Beilage, S. 61.

⁷ Thiriar: *Congrès de Chir.*, Proc. verb., Paris, 1893, vii, 318.

⁸ Gordon: *Brit. Med. Jour.*, 1900, i, 1338. ⁹ Lotheissen: *Centralbl. f. Chir.*, 1898, xxv, 548.

known recurrences as follows: A vertical incision is made over the hernial mass, and the sac and attached fat are separated up to its neck. After the hernia is reduced the sac is removed and sutured at its neck, after which its peritoneum retracts within the abdomen. A silkworm-gut suture threaded through a round curved needle is passed from above downward through Poupart's ligament and (the femoral vein being retracted outward) then through the fibrous structures over the ramus of the pubis; it is then reintroduced from below upward through Gimbernat's ligament and next through Poupart's ligament, when the suture is tied. This obliterates the canal. The skin is then sutured. The method has given uniformly good results with primary healing of the wound in every case.

UMBILICAL HERNIA.

Umbilical hernia may be considered under three classes: (1) congenital hernia of the umbilical cord; (2) the umbilical hernia of children; and (3) the umbilical hernia of adults. The first class includes by far the greater number, and they range in size from those containing only Meckel's diverticulum, which may be inadvertently tied and cut with the cord, to those as large as a child's head, containing a large portion of the abdominal viscera.

These congenital hernias of the cord are really cases of *ectopia* or malformation, for they represent a failure of the abdominal viscera to completely withdraw from an original fetal position, rather than a hernia or protrusion through the abdominal wall.

Care should always be exercised in ligating the cord that there be no unusual swelling or protrusion about its proximal end. If a loop of gut or the diverticulum of Meckel be discovered, the contents should be carefully reduced and held in place by a sterile wad of gauze firmly bound over the cord. Adhesive straps may be used and so placed as to bring the recti muscle in apposition. For the larger hernias the indication is a reduction of the contents, excision of the sac, and apposition of the walls, at the earliest possible moment consistent with good technic. For the very large hernias, containing so much of the abdominal viscera that their return will interfere with the vital function, the outlook is necessarily bad.

The umbilical hernias of childhood occur most frequently in the first year of life. Indeed, there are probably many umbilical hernias during the first few years of life which undergo spontaneous cure and are never noticed. In the process of atrophy of the cord and cicatrizing of the tissues about its base there is left the umbilical ring, into which dip the umbilical vein above and the arteries below. This ring becomes contracted and firm only with the progress of time, and it seems remarkable that the crying and straining of the first few weeks of life do not result in more hernias. The protrusion generally takes place through the upper border of the ring, as the large, loosely attached vein in this region offers less resistance than the more firmly attached arteries at the inferior border. If the hernia be small, it is usually globular; while if larger, it becomes conical.

Many hernias of this class undergo spontaneous cure. Many more may be

slaging. A good method is the early application of adhesive
anner that the skin over the hernia is brought together in
f the child is older, one may use a silk elastic bandage
body and contains a broad pad or button to cover
not cured by the tenth year, operation is
ov with apposition of the separate layers

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ility, and strangula-
part of its contents.
the high death-rate from
(50 per cent.) in this class
uses led to the devising of all
anner of harness for the retention
of these hernias. Since the general
adoption of the plan advocated by
Wm. J. Mayo,¹ of operation by over-
lapping the abdominal walls vertically,
there are few such cases that cannot
be given a large measure of hope by
the experienced surgeon. That pa-
tients see the surgeon in an earlier
period in the development of the malady is also a factor in the improved statistics.

Our former efforts at closure of the umbilical hernia by lateral flap methods are well represented by the description of Piccoli,² who aimed by splitting and overlapping to get a strong double layer of abdominal wall in place of the opening. But those who have attempted to replace voluminous contents in a contracted abdominal cavity and then to close the large opening by making use of the atrophied tissues laterally,

¹ Mayo, Wm. J.: *Ann. of Surg.*, 1899, xxix, 51. ² Piccoli: *Centralbl. f. Chir.*, 1900, xxvii, 36.

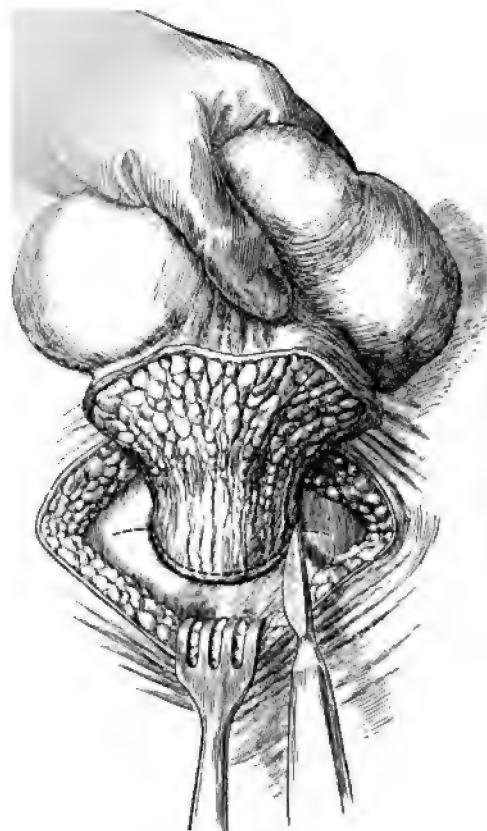


FIG. 792.—OPERATION FOR THE RADICAL CURE OF UMBILICAL HERNIA, MAYO'S METHOD.

Showing the transverse incision, exposure of the aponeurosis of the recti, circular division of the neck of the sac, transverse incisions in aponeurosis.

can best appreciate the attempts of various surgeons to find some mechanical appliance to fill in the defects of autoplasty. O. Witzel,¹ of Bonn, closed large hernial apertures by weaving in a fine meshwork of silver wire; while Goepel, of Leipzig,

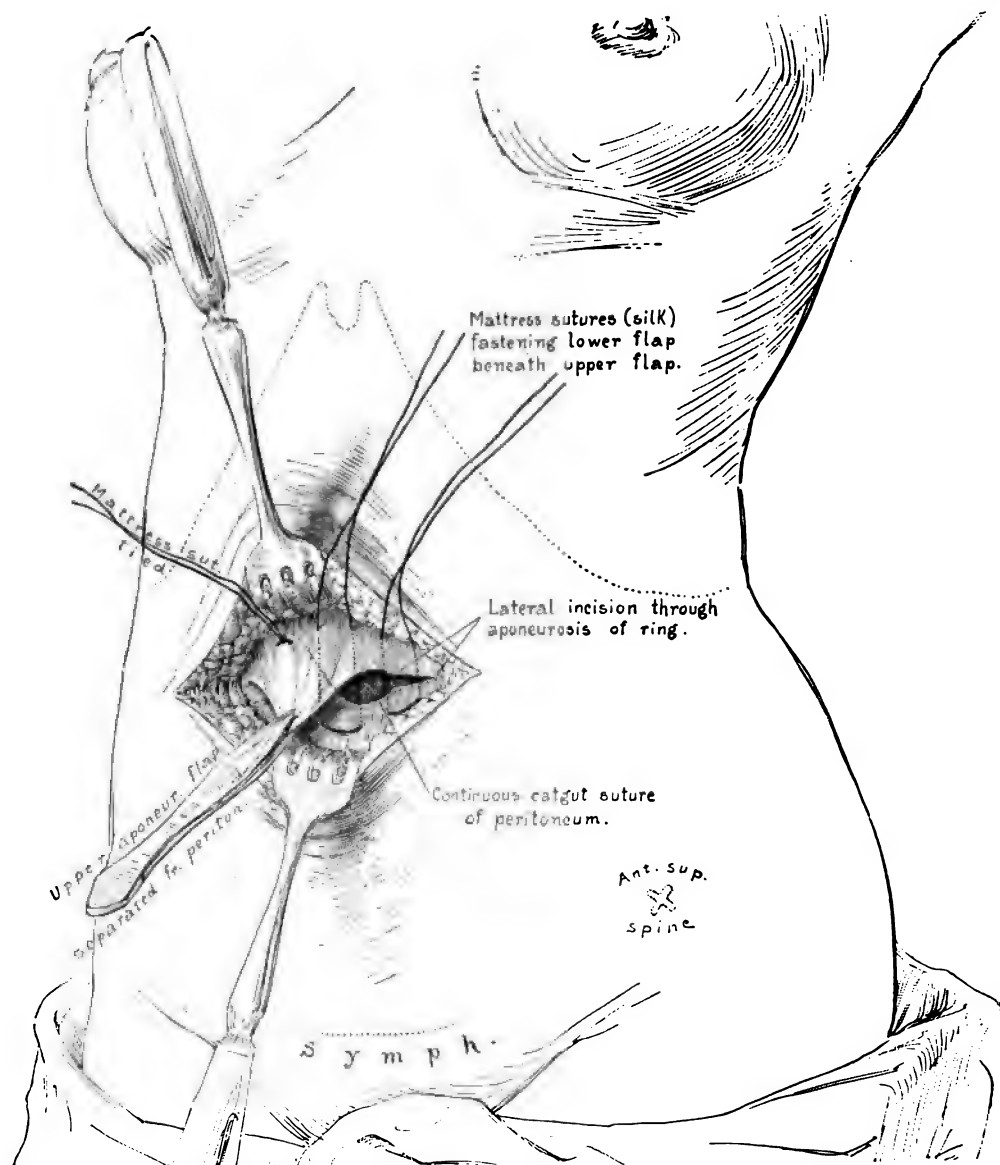


FIG. 793.—OPERATION FOR THE RADICAL CURE OF UMBILICAL HERNIA, MAYO'S METHOD (Kelly).

in the same journal reported work with ready-made silver wire netting, and claims for his methods of implantation of the silver filigree pad, the advantage of less injury to the tissues, less time for operation, an even network of wire that will not

¹ Witzel, O.: Centralbl. f. Chir., 1900, xxvii, pp. 257, 457, 1149.

spread at any point, and a minimum amount of wire left in the tissues. He has pads made in various sizes and shapes to correspond to the size of the hernial orifice and to the anatomic outline of the portion of the body in which the hernia occurs.

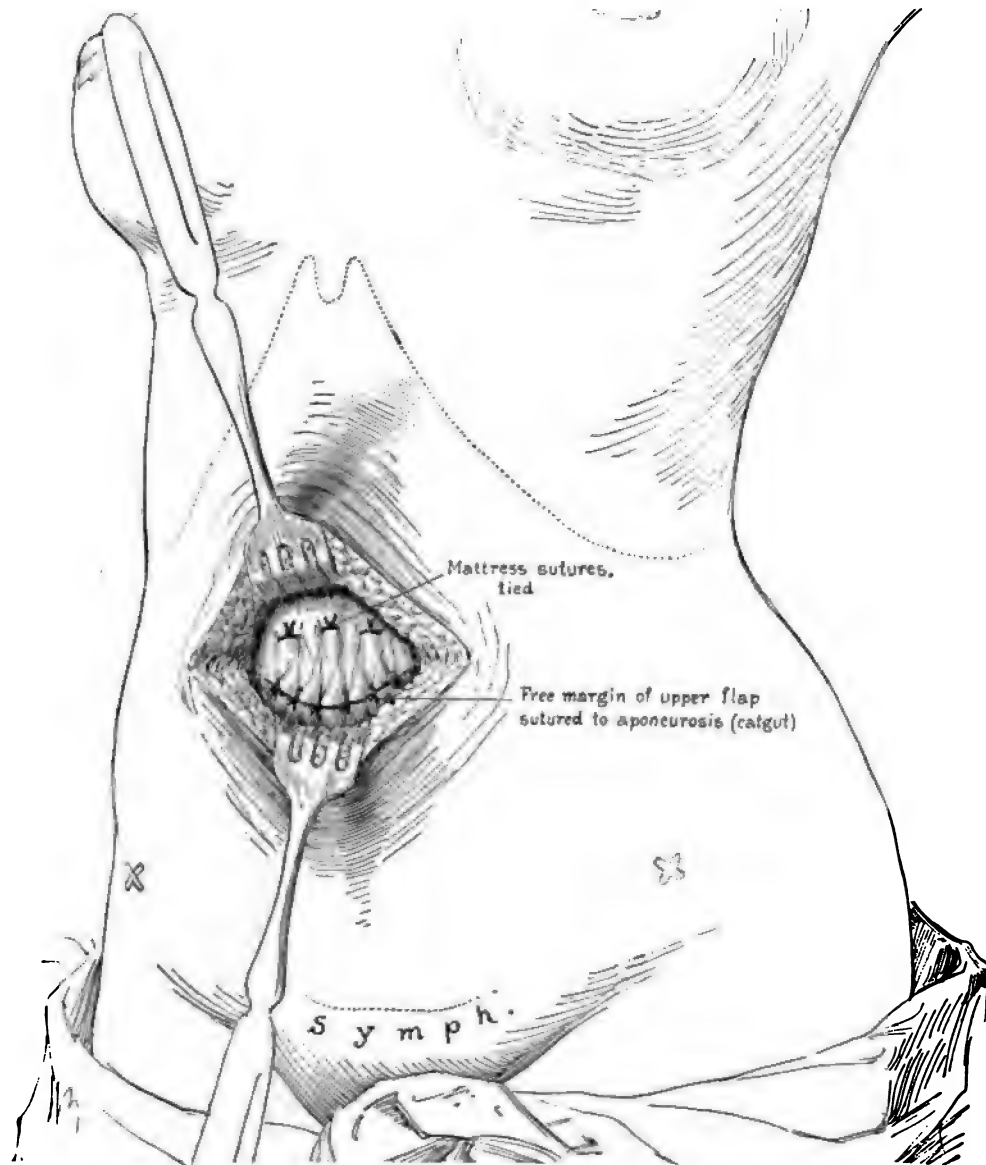


FIG. 794.—OPERATION FOR THE RADICAL CURE OF UMBILICAL HERNIA, MAYO'S METHOD (Kelly).

The pad overlaps the hernial orifice and is strongly fastened to the surrounding tissues with silver sutures. Phelps,¹ of New York, had been working with the heteroplastic methods since 1892, but did not publish his results until September 22, 1900.

¹ Phelps: N. Y. Med. Record, 1900, lviii, 441.

Willy Meyer¹ reports three cases in which he has used the ready-made silver filigree pads.

The operation first published by Mayo,² and which has revolutionized the results in this difficult class of cases, is described as follows (Figs. 792, 793, 794):

1. Transverse elliptical incisions are made surrounding the umbilicus and hernia; this is deepened to the base of the hernial protrusion.

2. The surfaces of the aponeurotic structures are carefully cleared $2\frac{1}{2}$ to 3 inches in all directions from the neck of the sac.

3. The fibrous and peritoneal coverings of the hernia are divided in a circular manner at the neck, exposing its contents. If intestinal viscera are present, the adhesions are separated and restitution made. The contained omentum is ligated and removed with the entire sac of the hernia and without tedious dissection of the adherent portions of the omentum.

4. An incision is made through the aponeurotic and peritoneal structures of the ring extending one inch or less transversely to each side, and the peritoneum is separated from the under surface of the upper of the two flaps thus formed.

5. Beginning from 2 to $2\frac{1}{2}$ inches above the margin of the flap, three or four mattress sutures of silk or other permanent material are introduced, the loop firmly grasping the upper margin of the lower flap; sufficient traction is made on these sutures to permit peritoneal approximation with running suture of catgut. The mattress sutures are then drawn into position, sliding the entire lower flap into the pocket previously formed between the aponeurosis and the peritoneum above.

6. The free margin of the upper flap is fixed by catgut sutures to the surface of the aponeurosis below, and the superficial incision closed in the usual manner. In the larger hernias the incision through the fibrous coverings of the sac may be made somewhat above the base, thereby increasing the amount of tissue to be used in the overlapping process."

The ease of performing this operation, the shortened anesthesia, the relatively slight handling of the sac contents, and the comparative ease of closing the wound without bringing about a tremendous increase of intra-abdominal pressure, are a few of the factors which have changed one of our most dangerous and dreaded surgical procedures into an operation of comparative ease and safety.

VENTRAL HERNIA.

Under this designation are included all hernias of the anterior abdominal wall except umbilical and inguinal hernias. According to their location, we speak of median ventral hernia, or hernia of the linea alba, and lateral ventral hernia. Those

¹ Meyer, Willy: *Ann. of Surgery*, 1902, xxxvi, 767.

² Mayo: *Jour. Am. Med. Assoc.*, 1903, xli, 225. Charles P. Noble, of Philadelphia, who since 1896 has been an enthusiastic advocate of the overlapping method in closing wounds of the abdominal wall, had already closed large umbilical hernias by overlapping from above downward (*Ann. of Surgery*, March, 1906, xliii), his first operation with overlapping from above downward being performed Feb. 14, 1898, and his operation with lateral overlapping in 1894.

hernias occurring in the median aponeurosis, even if they be to one side of the linea alba, are classed with the median ventral hernias.

In this day of abdominal surgery by far the greater number of ventral hernias are post-operative, and to these a special section will be given. The following observations on the development and frequency of ventral hernia are made without reference to the post-operative variety.

The linea alba is formed by the interlacement of aponeurotic fibers from the two sides, and as it descends from the xiphoid process to the umbilicus it grows broader and thinner. Below the umbilicus the linea alba is narrower and thicker. Hernia of the linea alba is common above the umbilicus, and in this situation is known as epigastric hernia. Hernia of the linea alba lying immediately above the umbilicus may so overhang this region that it is confounded at birth with hernia of the umbilical cord, but in such cases careful examination enables one to trace the cord back to the abdominal wall.

Occurring usually in adult life, epigastric hernia is generally supposed to be due to some congenital or acquired defect in the fascia of the linea alba, through which the peritoneum and hernial contents find their way on the occurrence of some unusual trauma or pressure from within. It is usually stated that pregnancy is a prominent factor, but Berger's figures are striking in this regard. Of 10,000 hernia patients, 137 had the epigastric variety, and 117 of these were in males, while only 12 were in females above the age of fifteen. In speaking of hernia we must carefully exclude diastasis of the recti, so often seen in parturient women, and the analogous supra-umbilical eventration seen in the crying child.

Perhaps one of the most frequent *causes of ventral hernia*, and surely the most difficult factor in diagnosis, is the subperitoneal lipoma. These subperitoneal fatty tumors are most common in the linea alba, femoral and umbilical regions. They develop from the layer of fat lying immediately beneath the peritoneum and make their escape through the linea alba or the natural abdominal openings by following the blood-vessels which run from the subperitoneal region outward into the abdominal walls. Reaching the prefascial region, they may undergo development and present signs and symptoms that cannot be distinguished from hernia. They often have the consistence of an omental hernia, and they may be wholly or partially returned to their neighboring abdominal orifice, to again protrude with any sudden increase of the intra-abdominal pressure, as from coughing. By dragging on the peritoneum they produce reflex gastric and other symptoms similar to those of abdominal hernia, and by pulling out a diverticulum of peritoneum a beginning hernia is determined.

The *symptoms* of epigastric hernia and of the frequently associated properitoneal lipoma may easily be inferred by considering some of the more common maladies for which they are mistaken. The incidence of epigastric hernia (about 1 per cent. of all hernia cases) is not an indication of its great importance. Too little attention has been given in the literature to the relative frequency with which patients suffering from this easily cured malady are subjected to all manner of treatment for obscure

abdominal conditions. Kuttner¹ makes an exhaustive review of the literature and finds this condition mistaken for gastralgia, enteralgia, gastric ulcer, and carcinoma, for cholelithiasis, and for neurasthenia, hysteria, and hypochondriasis. More recently D. D. Stewart² has emphasized the importance of this form of hernia in the work of the diagnostician. Lothrop³ emphasizes the clinical importance of the fatty tumors of the epigastrium and discusses their relationship to epigastric hernias.

POST-OPERATIVE HERNIA.

Faulty closure of an abdominal wound, suppuration, and the use of drainage are the chief factors in the causation of post-operative hernia. The use of catgut sutures which become absorbed too soon, and particularly the placing of sutures at wide intervals, are factors determining the separation of abdominal wounds which immediately after operation seem to have healed perfectly. The post-operative distention, vomiting, and coughing, undoubtedly serve to drive a wedge of omentum or intestine into any part of the fresh incision not properly protected by suture, and only after weeks or months does the protrusion work its way outward sufficiently to be diagnosed as a ventral hernia. As prophylactic measures we recognize the value of using the gridiron incision (McBurney) whenever possible. For gall-stone surgery and for combined operations on the appendix and pelvic organs it is often advantageous to make a rectus muscle (Battle) incision. Whenever possible, the nerves and vessels in the line of the incision should be respected and drawn to one side rather than cut, thus preventing post-operative atrophy and weakness. As most gynecologic operations are done through a median hypogastric incision, and because of the great length of the incision in many cases, it becomes imperative that great care be used in the closure. C. P. Noble⁴ has repeatedly called attention to the importance of the overlapping method in closing wounds of the abdominal wall. At the end of an operation done through a suprapubic median incision a continuous catgut suture closes the peritoneum. If this suture passes through the peritoneum just back of its free border on either side, the free borders are apposed and turned toward the peritoneal cavity to form a buttress line which must aid materially in preventing any wedge of omentum from slipping into the line of incision. If both rectus sheaths have not been opened in making the initial incision, they must now be opened and the rectus fibers freed and apposed by a running catgut suture, which occasionally picks up the peritoneum so as to prevent the formation of a blood-clot between the peritoneal and muscular layers. Heavy catgut or silk sutures now overlap the outer aponeurosis of the rectus muscles and give the wound its initial strength until thorough organization has taken place. The method of closure of the sub-

¹ Kuttner: *Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie*, 1896, Bd. i, No. 26, S. 661.

² Stewart, D. D.: *Amer. Med.*, 1905, Bd. x, p. 185.

³ Lothrop: "Hernia Epigastrica and Fatty Tumors in the Epigastrium," *Med. and Surg. Reports of the Boston City Hospital*, 1901, p. 66.

⁴ Noble, C. P.: *Med. News*, Dec. 17, 1904, lxxxv, 1162.

cuticular fat and the skin is immaterial to the strength of the wound if one avoids infection and the accumulation of a blood-clot. When drainage becomes necessary at the primary operation, or if a wound must be opened and drained because of an infection involving its fascial and muscular layers, the patient should be kept on her



FIG. 795.—SHOWING OPERATION FOR HERNIA DOVETAILING RECTUS BETWEEN THE BROAD ABDOMINAL MUSCLES.

back in bed for from one to four weeks longer than is necessary after healing *per primam*. A well fitted abdominal binder should be worn for some months and the patient should be told of the possibilities of a hernia after a drainage operation.

Treatment of Post-Operative Hernia.—The tendency of a post-operative hernia is to increase in size in spite of bandage or truss treatment, and for this reason

early operation is indicated. Evidences of post-operative hernia generally appear within six months. The hernia seems to grow larger and more rapidly in obese women, probably because of a greater intra-abdominal pressure due to the relatively large amount of intra-abdominal fat, and because of the inability to apply an abdominal binder closely to the hernia opening. In such cases the surgeon may always count on the hernia having burrowed into the subcutaneous fat to a wider degree than is apparent from the external physical examination. The operation for post-operative hernias varies with the size, position, and other characteristics of the hernia, and follows the general principles advocated elsewhere in this chapter for the closure of other hernia wounds. If possible, the layers of the abdominal wall entering into the formation of the hernial ring should be individualized by dissection and sutured separately, as in the closure of a fresh abdominal wound, overlapping the fascia when possible. In the case of large median line hernias the overlapping will be best accomplished vertically, as in the description for ventral hernia. Hernia following operations through the linea semilunaris present difficulties because of the

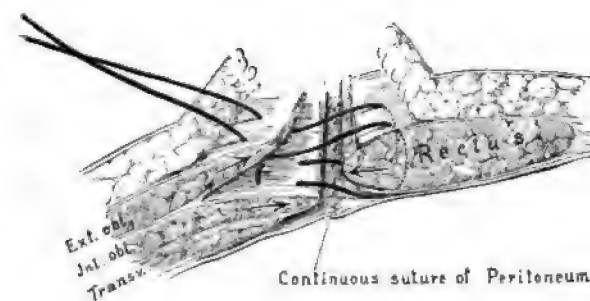


FIG. 796.—SHOWING IN DETAIL METHOD OF DRAWING RECTUS BETWEEN MUSCLES.

different directions of the rectus and the oblique muscles. Figs. 795 and 796, taken from Kelly's work on appendicitis, illustrate the method used in closing such a hernia.

"After dissecting out the scar tissue the margin of the rectus muscle is exposed, clean and clear, throughout the entire length of the wound.

The lateral muscles are like-

wise laid bare. The next step is to split the lateral muscles, separating the external oblique with its stronger fascia from the internal oblique and the transversalis below. The sutures are shown in full view in Fig. 795, while Fig. 796 exhibits the method of passing a single suture in profile."

LUMBAR HERNIA.

Most hernias of the lumbar region are traumatic in origin, following operations or suppuration. We will speak of the spontaneous variety only. Jeannel¹ has collected sixty-three cases of lumbar hernia, ten of which he classifies as congenital, and fifty-three as acquired hernias. Formerly hernias of this region were all supposed to protrude at the triangle of Petit, but in 1866 Grynfeldt² called attention to the triangular space of fascia immediately inferior to the twelfth rib, which fascia is covered by the latissimus dorsi muscle. He considered this a possible site of lumbar hernia, and shortly after Lesshaft, in agreeing with this view, named the space the

¹ Jeannel: Archives provinciales de Chirurgie, 1902, tome xi, p. 389.

² Grynfeldt: Montpell. Med., 1866, xvi, 329.

"trigonum lumbale superius," to distinguish it from Petit's triangle, the "trigonum lumbale inferius." Jeannel operated upon a case presenting in this space.

Braun in 1879 showed by a careful dissection at autopsy in a case of lumbar hernia that this variety may find its exit from a small space immediately back of Petit's triangle. This opening penetrates the fibrous iliac insertion of the latissimus dorsi and normally gives passage to the dorsal vessels and nerves of the buttock. Gravitation abscesses and at times pus from the pelvic region may find exit at this point. A review of the literature seems to indicate that a lumbar hernia may protrude in either of these regions, and, in fact, from any portion of the quadrilateral space between the ribs and the ilium. Congenital malformation or weakness, traumatic injury to the tissues of this region, pathologic changes, as from pelvic inflammatory diseases, cold abscesses, or caries of the ilium, or the various paralyses, may determine the formation of lumbar hernia. Abscess and lipoma must be considered in making a diagnosis. In the treatment, pads and trusses have been worn with more or less satisfaction. A number of cases of strangulation have been reported and the operation for non-strangulated cases has been very successful.

OBTURATOR HERNIA.

Fortunately, obturator hernia is rare. It is seldom that this variety reaches a sufficient development to present in a discoverable manner, and for this reason it is generally only after strangulation that a diagnosis is made. Leaving the pelvis through the obturator canal, with the obturator vessels and nerve, the hernial sac may be confined beneath the obturator externus and the pectineus muscle, and form only a slight flat protrusion; or by thinning these muscles or separating their fibers it may work its way forward and appear beneath the skin, in which case it is generally of large size and easily mistaken for a femoral hernia. Because of the firm borders of the obturator canal, it is a favorite seat for hernia of the intestinal wall, and this should always be borne in mind in the presence of symptoms of intestinal obstruction with no discoverable cause. With the symptoms of intestinal obstruction, the presence of a flat tender swelling over the region of the pectineus muscle, and flexion of the hip, strangulated obturator hernia may be diagnosed. In making a diagnosis of obturator hernia one must exclude femoral hernia, which is situated above and external to the site of obturator hernia. Lipoma must be excluded. Abscesses arising within the pelvis or from the bone may point in the usual location of an obturator hernia. The presence of the Howship-Romberg symptom is important. The terminal filaments of the anterior branch of the obturator nerve are sensory and supply the skin over the inner side of the thigh. Pressure of the hernia upon the nerves as they both course through the canal may cause intense pain and various paresthesias referred to the area supplied by the terminal sensory filaments. The hip-joint is flexed and an attempt to extend it is painful. If a strangulated obturator hernia has been diagnosed, an incision is made over the site of the hernia internal to the femoral vein. Great care should be used in relieving the constriction,

as the obturator artery always lies close to the neck of the sac, usually to the outer side. Reduction has been performed by stretching the obturator canal with the fingers. If all the indications point to a recent and mild strangulation, the bowel may be replaced, and this followed by a plastic closure of the external ring, using great care not to injure the vessels or nerves; but in the majority of cases satisfactory examination and treatment of the injured bowel can be obtained only by the peritoneal route. An incision should be made above and parallel to Poupart's ligament or in the linea semilunaris in order to easily reach and treat the internal ring of the obturator canal.

SCIATIC HERNIA.

Hernia of the sciatic region may protrude through either of three openings. If it follows the gluteal artery, it leaves the great sacrosciatic foramen above the pyriformis. It may follow the sciatic artery and penetrate the same foramen below the pyriformis, or it may leave the pelvis through the lesser sacrosciatic foramen. These hernias are of extreme rarity. They may be confounded with certain perineal hernias which protrude back of the rectum and appear below the lower border of the gluteus maximus.

Omentum, intestine, ovary, and bladder have been found as contents of sciatic hernia. A diagnosis should be made from lipoma, abscess, and aneurism of the gluteal or sciatic arteries.

PERINEAL HERNIA.

Under this heading we exclude the ordinary protrusions and prolapses resulting from the relaxation of the pelvic floor and ligaments, and consider only those cases in which the abdominal or pelvic viscera actually escape through the pelvic diaphragm and reach the ischiorectal space. The pelvic diaphragm is formed by the funnel-shaped layer of muscle composed of the coccygeus and the iliac and pubic portions of the levator ani. These muscles have reinforcement, and their interspaces are bridged over by the stronger superior and inferior pelvic fascias. A perineal hernia escapes either between the muscle fibers or through the interspaces between the individual muscles of the pelvic floor, and enters the ischiorectal fossa. Having reached the loose areolar tissue of the fossa it remains undiscovered, or advancing to the skin, it is recognized as an ischiorectal hernia; working backward, it forms the so-called rectal hernia; pushing forward, it may appear under the skin as a perineal hernia in men or a pudendal hernia in women (Figs. 790, 797, 798). Either of these varieties in women may become vaginal hernia, and even carry the vaginal wall out through the vulvar orifice (prolapse hernia). An anterior vaginal hernia forms an exception in that it does not reach the ischiorectal fossa, but escapes directly toward or into the vagina by separating the vesico-uterine tissues. On the other hand, a hernia may separate the vesico-uterine tissues and then make its way laterally through the levator ani, thus reaching the ischiorectal fossa and the labium. The author recently operated on such a case, using both the perineal and abdominal routes.

A rectal hernia may carry with it a portion of the bowel and cause a prolapse hernia analogous in its origin to that of the vagina. Fatal errors have resulted by confounding perineal hernias with uterine polyp and pelvic abscess. In addition to these conditions, a diagnosis must be made from vaginal cyst, prolapse of the vagina, cystocele, and rectocele. The records of operative measures for this condition are very meager, but in view of the tendency of these hernias to increase in size, and because of the difficulties of treatment by supports, it would seem best to resort to the radical operation in all favorable cases. The case is unfavorable if the pelvic



FIG. 797.—PERINEAL HERNIA.

Showing protrusion of the intestinal contents into the labium and vagina. Thickening of the skin posterior to the commissure. Johns Hopkins Hospital, Gyn. No. 11,385 (Operation by H. A. Kelly.)



FIG. 798.—PERINEAL HERNIA. SAME AS FIG. 797, SHOWING THE SAC LAID OPEN.

muscles have been so widely separated that a hernial ring cannot be palpated. The great depth of the hernial ring from the suprapubic incision makes the perineal route preferable in most cases. The perineal incision should be made outside of and parallel to the constrictor vaginae muscle. After making the skin incision the ischio-rectal fossa is reached by blunt dissection. If the hernia comes through the posterior portion of the levator ani muscle, a more liberal exposure is obtained by cutting through the median end of the transversus perinei and carrying the incision down to the sphincter ani. By making use of blunt dissection in the deep work it is not necessary to tie or cut the vessels of the ischio-rectal region.

DIAPHRAGMATIC HERNIA.

Diaphragmatic hernia usually occurs on the left side, and the protrusion may take place through its central tendon, through its muscular portion, or through any of the natural openings for the vessels, sympathetic nerves, or esophagus. Many diaphragmatic hernias are due to arrest of development and are not hernias in the strict sense of the term. By far the largest number have no sac. The diagnosis is rarely made *intra vitam*. Gastric disturbances with radiating pain in the thorax may lead to the finding of a marked thoracic displacement of abdominal tympany. These signs, together with a dextrocardia, would be very suggestive of diaphragmatic hernia. The condition is usually found at autopsy upon infants. In adults the condition has not been treated except in the presence of strangulation, when the practice has been to perform a laparotomy and draw the viscera back into the abdomen. With the advances in thoracic surgery it is probable that such cases, when a certain diagnosis is possible, will be treated through the thoracic wall, according to the suggestion by Perman. Rydygier¹ gives the following reasons in favor of the thoracic route: (1) an abdominal wound usually opens the pleural cavity; (2) the diaphragm is more easily reached and sutured through the thoracic route; (3) by opening the thorax the negative pressure of the pleural cavity is overcome, thus insuring the reposition of the hernia contents. A successful diaphragm suture is not easy, particularly if the hernial opening be large, and it is possible that the silver filigree pad will become useful for these cases. In view of the large proportion of strangulation in diaphragmatic hernia, the radical treatment is indicated as soon as a certain diagnosis can be made.

INTERNAL HERNIA.

An internal, retroperitoneal, or intra-abdominal hernia is one arising in one of the normal peritoneal recesses or in a peritoneal recess formed in the course of the body development. In the shifting of the gastro-intestinal canal from the straight tube of early fetal life to the complex relationships of full development there are formed several folds and fossæ which determine the sites of internal hernia.

In the order of their importance we may speak of: (1) hernia of the duodenal fossæ; (2) hernia of the ileocecal and retrocecal recesses; (3) hernia through the foramen of Winslow; (4) hernia of the intersigmoid recess; (5) retrovesical hernia.

Treitz² first pointed out that hernias of the duodenal, cecal, and sigmoidal regions possess sacs composed of the normal peritoneal folds of these regions.

Hernias of the duodenojejunal region, commonly called Treitz's hernias, are divided by Moynihan³ into left and right duodenal hernia. The left duodenal hernia, having its origin in the para-duodenal fossa (Landzirt) (see Fig. 616), is by far the most common, more than sixty-five cases being referred to by Moynihan.

¹ Rydygier: "Osteoplastische Thoracotomie." ² Treitz: "Hernia retroperitonealis," Prag, 1857.

³ Moynihan: "On Retroperitoneal Hernia," London, 1906.

The orifice is about opposite the third lumbar vertebra and is bounded by the mesenteric vein above and to the left. To the right is the duodenojejunal flexure, and inferiorly the neck is formed by the mesentery of the descending colon.

Right duodenal hernia¹ develops toward the right and beneath the superior mesenteric artery or its continuation, the ileocolic artery. Moynihan collected seventeen cases of this variety. Waldeyer first described a fossa situated in the mesentery of the upper part of the jejunum, and Brösike described the condition in which the jejunum for a greater or less distance is adherent to the parietal wall. The right duodenal hernia dissects up the adherent jejunum or makes a sac in the mesojejunum. In either case one leaf of the posterior peritoneum is pushed toward the right and the sac dissects up the peritoneum, and on reaching the ascending colon displaces this toward the right or dissects beneath it, displacing it toward the left.

The contents of either a left or right duodenal hernia may vary from a small knuckle of bowel to the inclusion of the entire small intestine.

The symptoms in a chronic long-standing case may be those of partial obstruction—pain, indigestion, and constipation. The acute cases are marked by the usual symptoms of acute intestinal obstruction, and should the sac contain a large part of the small bowel a probable diagnosis is possible; for in addition to the pain, obstipation, vomiting, and collapse, a localized tumor may be outlined. This is characterized by its rounded outline, tense cystic to solid feel, partial mobility, tympanitic percussion note, and intestinal sounds on auscultation. In addition, if the hernia be left duodenal, the compression of the inferior mesenteric vein may result in hemorrhoids and rectal bleeding and the development of collateral circulation through the superficial abdominal veins.

2. Hernia of the ileocecal and retrocecal recesses. Fig. 799 illustrates in a graphic manner the folds and fossæ of the ileocecal region. Moynihan collected seven cases of hernia of the ileoappendicular or ileocecal fossa; and of the sixteen cases reported of the retrocolic variety, he considers but seven as well authenticated. In none of these cases was there any considerable amount of bowel incarcerated, there being usually only a loop of ileum, and in the operative cases this was easily reduced.

3. Hernia into the foramen of Winslow is said to occur only under the following conditions: (a) when there is a common mesentery for the whole intestine; (b) in the absence of the secondary fusion of the ascending colon to the posterior abdominal wall; (c) with an abnormally large size of the foramen of Winslow; (d) with an abnormal length of the mesentery, and consequently undue mobility of the intestine. Twelve cases are recorded, the majority of these involving the small intestine. In Moir's case the entire small bowel was found in the lesser cavity, and in Treves' case the cecum, the ascending colon, and a portion of the transverse colon had entered the foramen of Winslow.

The diagnosis of hernia into the lesser cavity should be suspected if with the

¹ Waldeyer: "Hernia mesenterico-parietalis," Brösike, Berlin, 1891.

signs of acute intestinal obstruction there is unusual pain in the epigastrium and a tympanitic tumor in this region.

4. Moynihan accepts but two of the reported cases of intersigmoid hernia.

5. Sultan mentions four of the retrovesical variety.

We have not classified as retroperitoneal hernia those cases of mesentery openings with penetrating bowel. Akerman¹ reports such a case as an intra-abdominal hernia and collects the literature on the subject. His patient was operated upon

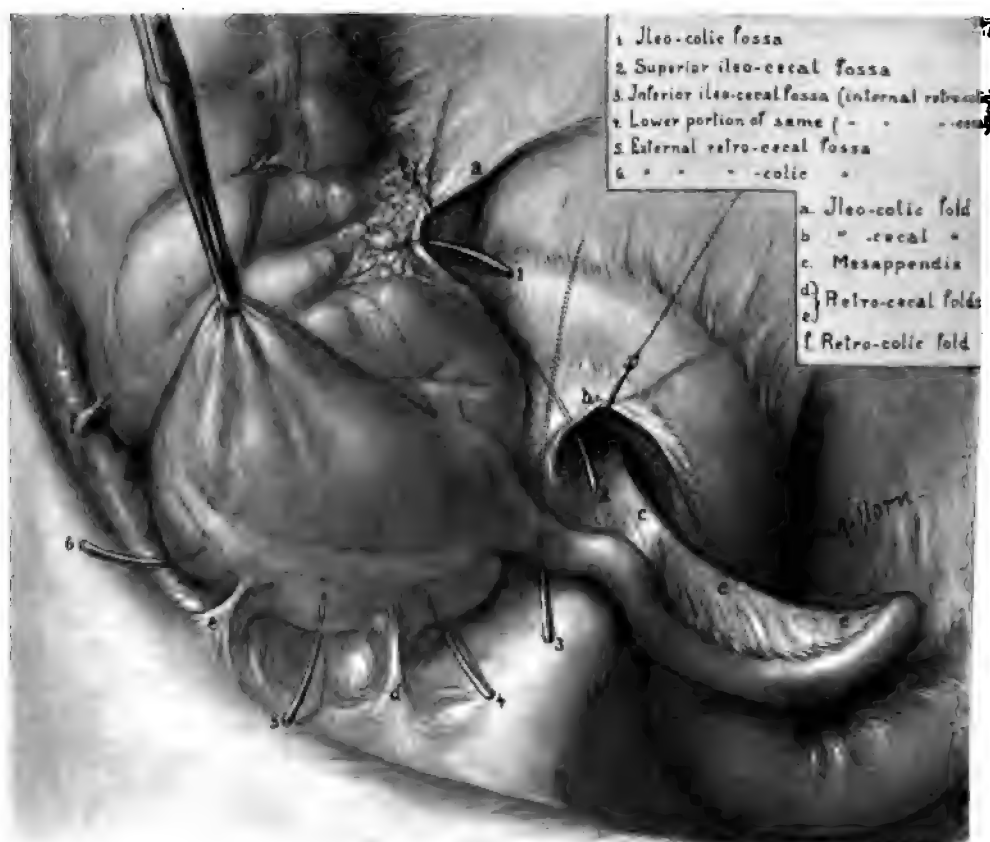


FIG. 799.—THE FOLDS AND FOSSÆ OF THE ILEOCECAL REGION.

The cecum is lifted up out of its bed in the iliac fossa, exposing the retrocecal folds and fossæ. The appendix has been drawn out of the ileocecal fossa to show the mesappendix.

because of long-standing symptoms, and an hour-glass stomach adherent to the left lobe of the liver was found. There was a large hole in the transverse mesocolon, through which penetrated a large portion of the small intestine. Three similar cases were known to Treitz,² and he considers the mesenteric openings to be secondary to the pathologic process in the stomach. As Treves³ pointed out,

¹ Akerman: "Intraabdominaler Bruch durch eine Öffnung im Mesocolon transversum," Nordiskt Medicinskt Arkiv, August, 1902, Häft 2, No. 9.

² Treitz: Ibid., p. 95.

³ Treves: Hunterian Lectures, Brit. Med. Jour., 1885, 1, 471.

the most frequent site of such openings is the mesentery of the ileocecal region; and this corresponds with Treitz's theory of an inflammatory basis. The bowel which passes through these openings is generally without a special covering, and for this reason, and because of the probable pathologic origin of the opening, we question whether such misplacements should be called hernias.

Treatment.—Attention will rarely be called to internal hernia except for the incidence of strangulation. Manski¹ found that strangulation occurred in about 20 per cent. of all cases. Fortunately the obstruction is due in many of these cases to a volvulus of the bowel rather than to compression at the neck of the sac. If the bowel is not easily reduced by traction, one may try to enlarge the neck by gradual stretching with the fingers. If a non-vascular area can be found in the neck of the sac, careful cutting with the knife or scissors will aid in the dilatation.

In case of failure to reduce the bowel Moynihan suggests the incision of the sac through a non-vascular area in the mesentery in case of a duodenal hernia, or through the gastrocolic or gastrohepatic omentum in the case of hernia into the lesser cavity. The bowel may be delivered through this incision and the volvulus straightened. If reduction is still impossible, the dilated bowel may be incised and emptied, and after suture it should be easily reducible.

After finding and relieving a strangulation in one of these pockets, the question of dealing with the hernial sac and the site of strangulation can only be settled by the circumstances of each case. Often it will be wise after the relief of the strangulation to ignore the sac and the orifice. Suture of the ring may present at least two dangers: first, since most of these hernias are of the duodenojejunal fossa, the suture might involve the inferior mesenteric vessels; second, closure of the hernial sac might give origin to a large peritoneal cyst. Intelligent packing with gauze may be of service in obliterating the peritoneal pocket.

¹ Manski: Münchener med. Wochenschr., 1893, xl, S. 435 u. 451.

CHAPTER XLI.

OPERATIONS FOR INGUINAL HERNIA.

BY EDWARD MARTIN, M.D.

Historical.—The ground has been adequately traversed by Hunner (Chapter XL), who justly awards to Marcy the large measure of credit due him for reviving the operation of radical cure, described and practised many centuries before.

Definition.—An inguinal hernia is an abnormal, recurring, or permanent visceral protrusion in the inguinal region wholly or partly invested with the parietal peritoneum.

The peritoneal investment of the lower portion of the anterior abdominal wall, viewed from behind forward, is raised into a series of folds. The central fold passing directly upward from the bladder fundus is caused by the obliterated urachus. On either side lie the folds of the obliterated hypogastric arteries. To the outer side of the obliterated hypogastric arteries, and corresponding to the position of the inner border of the internal ring, about midway between the anterior superior spinous processes of the ilium and the symphysis pubis, lie the folds indicating the position of the deep epigastric arteries.

Bounded by these folds or thickened bands laterally and by Poupart's ligament below are fossæ, or areas predisposed to yielding should there be abnormal intra-abdominal pressure.

The depression at the outer side of the deep epigastric artery is called the external inguinal fossa; in this fossa lies the internal ring, a parietal opening through the muscles and fascia left by the descent of the testis, and occupied by the vas and the vessels and nerves of the cord. From this fossa projects the peritoneal pouch which precedes or accompanies the testicle in its descent from its position below the kidney into the scrotum, and which, though it normally becomes obliterated except for that part forming the tunica vaginalis testis, often remains patulous in its upper part, predisposing to the development of hernia. A hernia developing in the external iliac fossa is called oblique.

The depression to the inner side of the deep epigastric artery, lying directly behind the external ring, is called the internal inguinal fossa. A hernia developing in this fossa is called direct. The hernial projection usually develops to the outer side of the obliterated hypogastric artery; exceptionally it projects to the inner side of this band, between it and the outer border of the rectus muscle.

A hernia which begins in the external iliac fossa, *i. e.*, to the outer side of the deep epigastric artery, before it becomes subcutaneous, must pass downward, and inward along the inguinal canal (2 to 5 cm.), then downward, outward, and forward,

pushing before it the intercolumnar fascia. There is thus mechanically afforded a valvular protection against the development of indirect inguinal hernia so efficient that the best designed and most successful operations of radical cure are those having for their end the reproduction and maintenance of these conditions.

The mechanical obstacles to the formation of an oblique, complete inguinal hernia in the person of a healthy, well-developed man are so great that it is difficult to imagine such a condition in the absence of a congenital predilection in the form of a peritoneal pouch left as a remnant after the descent of the testicle, nor is there clinical evidence wanting to show that the vast majority of oblique inguinal hernias developing in children and young men are dependent upon such a condition.

Direct inguinal hernia projecting through the internal inguinal fossa is due to the gradual yielding of the fascial parietes (conjoined tendon) to the inner side of the deep epigastric artery. When an oblique hernia has lasted for a long time and has reached considerable size, by dragging on its neck it pulls the inner opening so directly behind the external ring that the distinction between a direct and an indirect hernia can be made only by finding the pulsation of the deep epigastric artery.

The Varieties of Inguinal Hernia.—The principal varieties are the external or the oblique, and the internal or direct.

The external or oblique is, as has been noted, usually dependent for its development upon a persistent patulous condition of the peritoneal pouch which accompanies the testicle in its descent. When this pouch remains completely open down to the testicle, the condition resulting from the descent of viscera into this pouch is called congenital hernia. If this peritoneal pouch is closed at its lower point only, *i. e.*, above the testicle, the descent of intestine into it forms a hernia of the funicular process. When the pouch is closed at the internal ring, remaining patulous in the rest of its course, there may develop either the infantile or the encysted hernia. In the former a sac is formed from the neighborhood of the internal ring and descends behind the patulous vaginal tunic. Thus in reaching the hernial sac three layers of peritoneum must be traversed, *i. e.*, two of the vaginal tunic and one of the sac proper. In the encysted form of hernia the sac bulges into the vaginal tunic, thus necessitating the traversing of two layers of peritoneum before entering the hernial sac.

The hernia is called complete or incomplete in accordance with whether it does or does not project from the external ring. In the latter case it is often called bubonocele.

Of the incomplete inguinal hernias, those dependent upon congenital diverticula and often associated with testicular ectopy are particularly important because of the danger of strangulation.

The hernial sac in the case of oblique inguinal hernia, either developing in infancy or later in life, as the result of a persistent patulous condition of the upper part of the funicular process of the peritoneum, lies within the proper tunic of the cord and in its development passes into the scrotum. It lies usually in front of

the cord with the veins of the latter intimately adherent and spread about it. It may exhibit diverticula, valvular folds, or irregular seats of constriction. The diverticula at times may be as large or even larger than the more conspicuous sac, passing from the internal ring between the peritoneum and transversalis fascia in any direction, and in case of strangulation or incarceration misleading the surgeon in regard to the completeness of reduction (properitoneal hernia). Diverticula passing between the muscular layers are termed intraparietal; those projecting between the subcutaneous and deep fascia are called superficial.

The sac of the direct inguinal hernia is placed to the inner side of the cord, and though its coverings are practically the same it does not usually become scrotal.

The sac usually contains omentum and the small intestine. Upon the right side the appendix and cecum are frequently found, the latter sometimes lying completely within the sac; often, however, only partly covered by peritoneum, the whole mesenteric attachment having been dragged downward. Under such circumstances the sac is an incomplete one. The bladder has also occasionally been found as a part of the hernial projection, rarely with a complete peritoneal investment. On the left side a portion of the sigmoid flexure may form a part of the hernial contents, either a free loop passing into the hernial sac or, from sliding of its mesenteric attachment, the bowel being but partly covered by the hernial sac.

In size the hernia may vary from that of the last joint of the little finger, to be detected only by careful examination, to that of a keg or small barrel containing the greater part of the abdominal viscera.

Symptoms of Inguinal Hernia.—Symptoms of uncomplicated inguinal hernia vary from none at all, with the exception of a lump in the groin which comes and goes, to recurring pain of such intensity as to amount to complete disability.

Usually there is a sense of discomfort and weakness in the region of the groin, aggravated by lifting, coughing, or abdominal strain, associated with intestinal indigestion. There is a tumor which disappears on lying down, becomes obvious on standing, and prominent and tense on suddenly increased intra-abdominal pressure, as by coughing, straining, or lifting. This tumor is best located by invaginating the scrotum, with the little finger in the case of children, passing the tip of the latter as far as practicable through the external abdominal ring. Crying efforts then give to the finger-tip the sense of a soft jar as the viscus contained in the hernial sac is forced down. Thus may be detected hernias in their beginning.

In excessively fat people the detection of a hernia may be difficult, indeed quite impossible, since it has happened that even when strangulation has developed the most careful search in the inguinal region apparently excluded hernia as the cause of the trouble, though subsequent abdominal section demonstrated a loop of gut gangrenous from constriction of the internal ring.

Irreducible omental hernia, which may reach large size, simulates so closely lipoma—which indeed it is—that the distinction cannot be made in the absence of a history, though the tracing of a thick pedicle through the inguinal canal into the abdominal cavity will strongly suggest that the growth has a hernial origin.

Moreover, lipoma of large size, except that due to a herniated omentum, is rare in this region.

The distinction of hernia from hydrocele is based on a pronounced translucency of the latter, a single sign which must not be depended upon too absolutely in the case of infants, since a strong electric light will give a very fair degree of translucency in the case of congenital hernia made up of small gas-distended intestines and the feathery omentum characteristic of early life.

Some funicular hydroceles can be apparently traced along the inguinal canal into the peritoneal cavity and give an impulse, though not an expansile one, on coughing. They are dull on percussion, extremely translucent to transmitted light, give no gurgling, are in reality irreducible, though they may be pressed up into the inguinal canal and are not subject to sudden pronounced changes in size incident to alterations in intra-abdominal pressure. In infants such hydroceles are not infrequently combined with hernia.

Conditions Predisposing to Inguinal Hernia.—Inguinal hernia, the commonest of all forms of hernia, exhibits its greatest percentage of incidence in male infants and middle-aged men. There is no doubt that a persistently patulous condition of the peritoneal pouch is an almost invariable predisposing factor to the oblique inguinal hernias of infants and children and the usual favoring condition when similar hernias develop in the adult. Other predisposing factors are an unusually narrow origin of the internal oblique muscle from Poupart's ligament (Ferguson) and the presence of properitoneal lipomata or fat masses in the inguinal region.

Direct inguinal hernia is due to the failure upon the part of the fascia to withstand intra-abdominal pressure; hence sufficient predisposition to it is dependent upon all those causes which increase intra-abdominal pressure, such as obesity, ascites, chronic and harassing cough, or the straining of frequently recurring or difficult defecation or urination; associated with muscular and fascial degeneration.

These direct hernias are often double and bilateral. The hernia, if unilateral, is commonly on the right side; if bilateral it is usually larger on the right than on the left side.

Treatment of Hernia.—Prophylaxis, in so far as the adult is concerned, probably lies in the cure by operation of hernias occurring in infants. So many of these, however, recover with a simple truss that until the results of prolonged clinical study are available the possibility of many of the oblique inguinal hernias of the adult, especially those of slow formation, being due to imperfectly cured hernias in infancy stands on theoretic considerations rather than on the results of accurate observations.

Since, even with the formation predisposing to their development, hernias depend upon the failure of the musculo-fascial abdominal investment to resist intra-abdominal pressure, it is obvious that whatever tends to strengthen this investment will lessen the likelihood of hernia, and that whatever has the effect of increasing either the frequency or the violence of intra-abdominal pressure will have the contrary effect—

Exercises for the development of the abdominal muscles and for their maintenance in a healthy condition are particularly to be commended to middle-aged men of sedentary habit, with large external rings, pendulous bellies, and hereditary predisposition to hernia.

The affection once developed, the treatment should, as a rule, be operative. This treatment becomes imperative when the hernia is complicated by incarceration, strangulation, recurrent inflammation, persistent pain, or crippled intestinal indigestion.

The operation is advisable in all healthy children past the age of two years in whom a truss has not been curative, and in all vigorous adults in whom the hernia cannot be completely or comfortably retained by a truss.

Old arteriosclerotic men having visceral disease, and having large hernias and flabby parietes, should not be subjected to operation in the absence of complications which make this absolutely necessary.

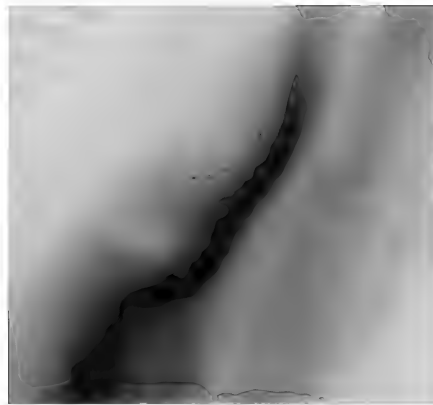
Preparation for Operation.—Where practicable, for three days before operation the patient should be fed moderately on a mainly nitrogenous diet, such as leaves but a small débris; should have his bowels opened regularly by mild laxatives, if these be indicated, not by active purgatives, and should take an intestinal antiseptic. The best is 5 grains of betanaphthol bismuth four times daily. The kidneys should be induced to secrete freely, nor, if there be a choice, should the operation be performed in the presence of a bronchitis or any pulmonary complication. The night before operation the patient is given a general bath, the area of operation is shaved and cleansed, the skin being not in the least irritated, and is protected by a spica bandage holding in place a dressing of sterile gauze. This dressing is repeated the morning before operation.

Anesthesia.—In the majority of robust patients the anesthetic of choice is nitrous oxid followed by ether, given by a skilled anesthetist. When an inexperienced resident only is available, local anesthesia is to be preferred; the latter, as a rule, in the elderly and infirm, those suffering from pulmonary complications and visceral disease or profoundly exhausted by the effects of the complications of strangulation.

Local anesthesia is feasible in all cases, but is difficult of successful application in the fat and the highly neurotic. Cushing¹ advised infiltration of the line of incision with Schleich's cocain solution, followed by immediate incision. He states that efforts to anesthetize the subcutaneous fat are futile. If the incision throughout its whole length is carried down to the aponeurosis, unanesthetized fibers of the iliohypogastric will be encountered in the superficial fat at the lower angle, together with one or two large veins, division of which is painful. Therefore the cut is deepened only at its upper angle; the aponeurosis of the external oblique is then opened in the line of fibers from the external ring, and the iliohypogastric and inguinal nerves are immediately cocainized with a 1 per cent. cocain solution as they lie under it. After this procedure the lower angle of the incision may be painlessly

¹ Cushing, Harvey: "The Employment of Local Anæsthesia in the Radical Cure of Certain Cases of Hernia," *Ann. Surg.*, Jan., 1900, xxxi, 1.

ring, and the intercolumnar fibers of the aponeurotic insertion of the internal oblique are to be cut, preliminary cocaine infiltration is necessary. The combined ilio-inguinal and ilio-lumbar nerves are reflected to one side, since its incision divides the cremaster muscle. The exposure of the internal ring of the infundibuliform fascia, the amputa-



oblique
covered by
fascia and
fibres.

after Harvey Cushing

FIG. 1. SHOWING USUAL SITUATION OF NERVE AS EXPOSED AFTER REFLECTION OF THE DIVIDED APONEUROSIS (Harvey Cushing).

tion of the sac at its neck, the closure of the peritoneal opening, the excision of the fundus of the sac, division of the cord, and castration, if deemed advisable, may now be done practically without pain. Occasionally some stray fibers of the genito-crural may be encountered about the neck of the sac which may require further infiltration.

Cushing notes that more time is consumed in the operation, and it is undoubt-

edly the case that careful dissection must take the place of rough stripping. This, however, is not a disadvantage.

Bodine,¹ as the result of his experience of several hundred cases, has become an enthusiastic convert to the method. He uses a 0.2 per cent. solution of cocain for infiltration of the skin and nerve-trunks. Elsewhere a solution of one-half this strength. He infiltrates the margins of the internal ring and also the line of incision through the tissues covering the hernial sac and the neck of the latter.

In the choice of the local anesthetic eucaïn is to be preferred to cocain, since it is only one-fifth as toxic and can be sterilized by boiling. Its benumbing effect is, however, more transitory.

Operation.—The operation varies in accordance with the conditions encountered. When the hernia is due to a patulous condition of the funicular peritoneal process, unless it has been of such long standing as materially to widen the internal ring and atrophy the surrounding muscles and fascia by pressure, all that is needful for cure is isolation of the sac, ligature of the neck, suture of the internal oblique muscle to Poupart's ligament, and closure of the wound with as little disturbance of tissue as possible. When, however, the hernia is of great size and long standing, even though it be oblique, it will have so materially weakened the posterior wall of the inguinal canal that an operation designed for the strengthening of this region will be needful.

In the case of direct hernias, the necessity for strengthening the abdominal wall will always be present.

In children with a well-developed musculature and a scrotal hernia protruding through a small internal ring the operation consists of a short incision over the inguinal canal, free exposure of the latter by splitting the fibers of the external oblique, separation of the sac up to the internal ring, twisting and ligation of the sac and its removal, unless it be total, in which case a portion sufficient to serve as a tunica vaginalis testis is allowed to remain. The internal oblique is stitched down to Poupart's ligament by one or two sutures, the cord not being disturbed. The external oblique is closed by overlapping.² In hernia complicated by undescended testicle a free division of all the structures of the cord, with the exception of its blood-supply, may enable the testicle to be brought into the scrotum; if this is evidently impossible, the testes can be pushed back into the pelvis, the sac being dissected free and closed.

When the sac communicates with the general peritoneal cavity by a wide opening, incident either to congenital muscular deficiency or to pressure atrophy, a more elaborate procedure is needful.

¹ Bodine, John A.: "A Plea for Local Anesthesia in the Radical Cure of Inguinal Hernia," *Med. Rec.*, Oct. 21, 1905, lxxviii, p. 645.

² Lucas-Championnière, Just.: "Cure Radicale de la Hernia Inguinale," April, 1901, Andrews, E. Wyllys: "Past and Present Obstacles to the Radical Cure of Hernia, with Demonstrations," *Jour. Am. Med. Assoc.*, 1897, xxviii, 868. Noble, Charles P.: "Overlapping the Aponeuroses in Closure of Wounds of the Abdominal Wall, including Umbilical, Ventral, and Inguinal Herniæ," *Ann. Surg.*, 1906, xliii, 349.

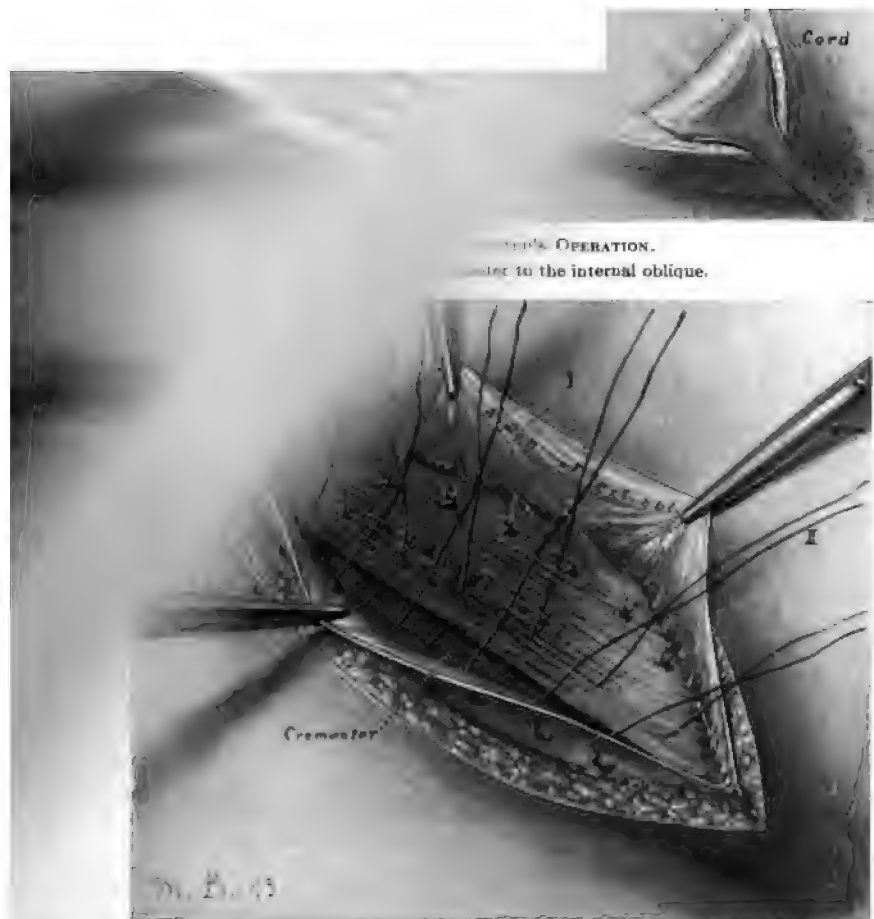


FIG. 804.—HALSTED'S OPERATION.

Suture of the lower edge of the internal oblique to Poupart's ligament.

firmly just before the ligature (in a needle with the blunt end first) is passed between them. As a precaution against slipping, we apply two ligatures of fine silk, both for the abdominal stump and for the testicle stump of the veins. The farther from the testicle the veins are divided, the better, provided, of course, that their stump is external to the external abdominal ring.

"Ligation of the sac is made by transfixion or by purse-string suture at the highest possible point. Both ends of this suture, after tying, are threaded on long curved needles, then carried far out under the internal oblique muscle from behind

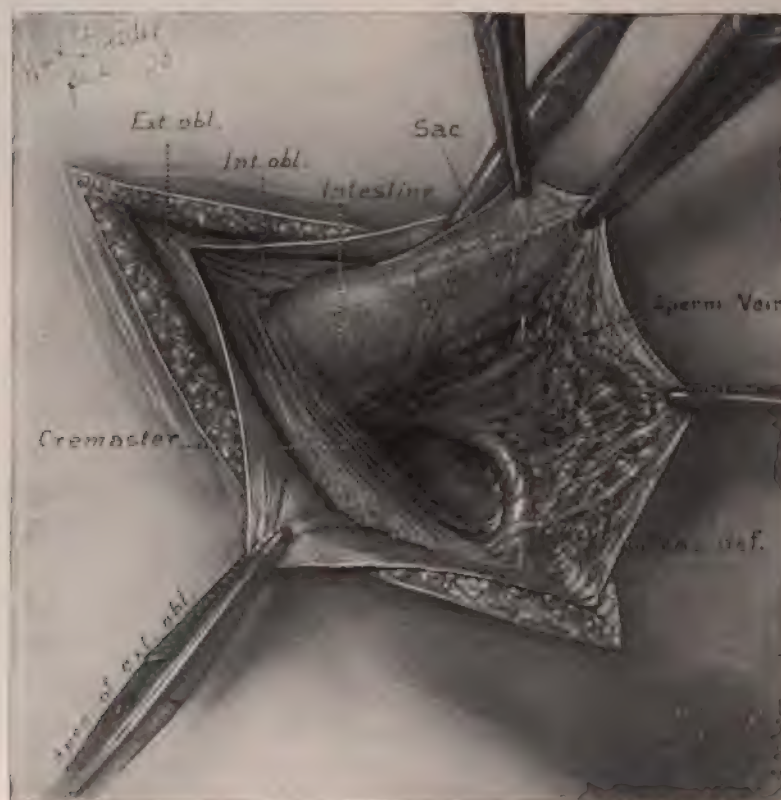


FIG. 802.—HALSTED'S OPERATION.

Exposure of the sac, the vas, and the spermatic veins.

forward, and, passing through this muscle, about 5 mm. apart, are tied. The idea was suggested to the author by Kocher's operation, the principle being essentially the same.

"The lower flap of the cremaster muscle and its fascia is drawn up under the mobilized internal oblique muscle and held in this position by very fine silk stitches, which, having engaged firmly a few bundles of the cremaster, perforate the internal oblique, preferably where it is becoming aponeurotic, and are tied on the external surface of the latter (Fig. 803).

"The internal oblique muscle, mobilized, and possibly further released by

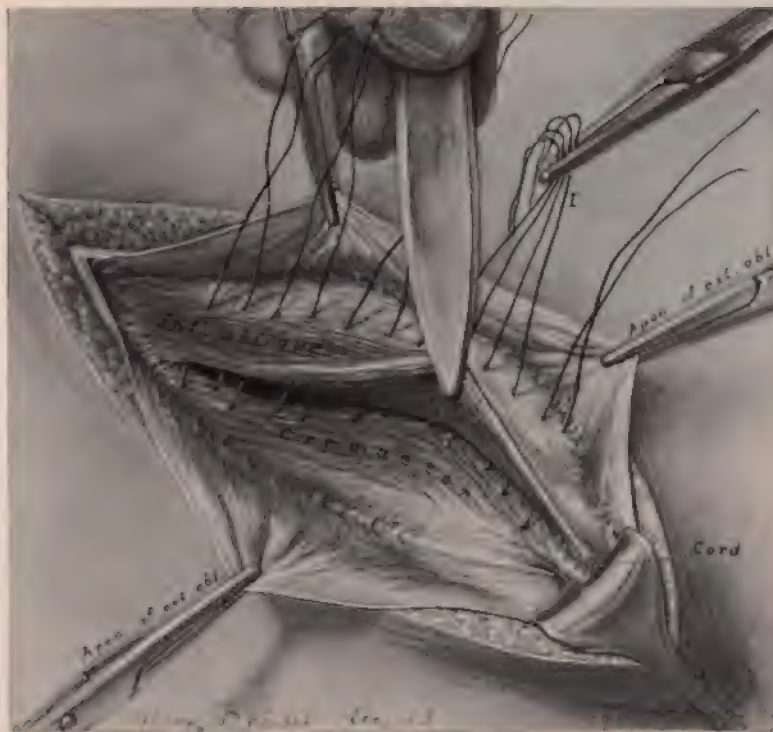


FIG. 803.—HALSTED'S OPERATION.
Suture of the cremaster to the internal oblique.



FIG. 804.—HALSTED'S OPERATION.
Suture of the lower edge of the internal oblique to Poupart's ligament.
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incising the anterior sheath of the rectus muscle, is stitched (the conjoined tendon also) to Poupart's ligament in the Bassini-Halsted manner (Fig. 804). Catgut is usually employed for this suture.



FIG. 805.—HALSTED'S OPERATION.
Suture of the aponeurosis of the external oblique.

“The aponeurosis of the external oblique muscle is overlapped (Fig. 805). This is known as Andrews' method, although devised independently by us.

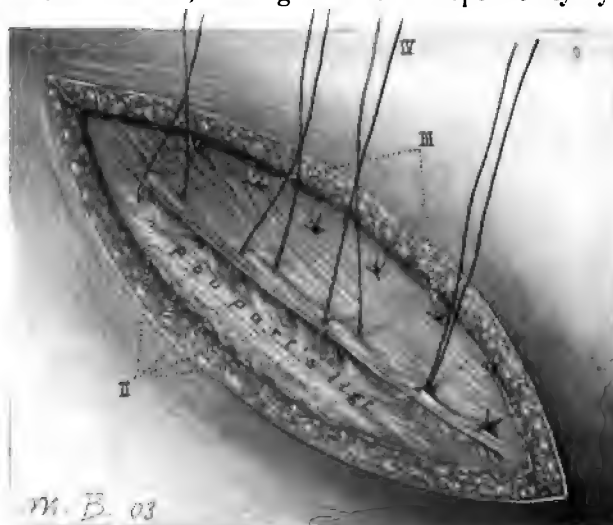


FIG. 806.—HALSTED'S OPERATION.
Suture of the margin of aponeurosis to Poupart's ligament.

“The skin is closed with a buried continuous silver suture, and the incision covered with five or six layers of silver foil. It is unnecessary to dress or examine a

wound closed in this manner for two weeks, when the wire may be withdrawn. Patients are kept in bed from eighteen to twenty-one days."

Bloodgood, whose wide clinical experience and painstaking study of the after-histories of cases of inguinal hernia treated by the radical operation entitle his opinion to general acceptance, thus describes his technic, in a personal communication:

"At the present time the operation is performed as follows: After dividing the aponeurosis of the external oblique muscle the internal oblique is separated well up to the rectus sheath as a McBurney gridiron. The sac is excised and closed. In doing this all the coverings of the sac with the cremaster muscle are preserved. In closing the wound the loosened internal oblique muscle and the conjoined tendon down to the cord are sutured to Poupart's ligament at some distance from the line of division, then this



FIG. 807.—HALSTED'S OPERATION.
Sectional view.



FIG. 808.—BASSINI'S OPERATION, I.
Grooved director in inguinal canal, lifting up aponeurosis of external oblique.

edge of Poupart's ligament is sutured to the sheath of the rectus, to the fascia of the linea semilunaris, and to the muscle of the internal oblique. This, I think, is the chief point of the operation, the fixation of the widely separated internal oblique muscle to Poupart's ligament. The aponeurosis of the external oblique is sutured over the structures just mentioned which have been approximated. If the veins are large, they are excised as in varicocele. This is the method that I have employed since my study of hernia was complete. I have found it necessary to transplant the

rectus muscle in a few cases, and as far as I know I have had but one recurrence." The patient is kept in bed for ten days.

Ferguson,¹ the simplicity of whose procedure commends it, but not more than the success which has attended its application, notes that the important feature in



FIG. 809.—BASSINI'S OPERATION, II.

Sac and cord raised *en masse* and held with fold of gauze.

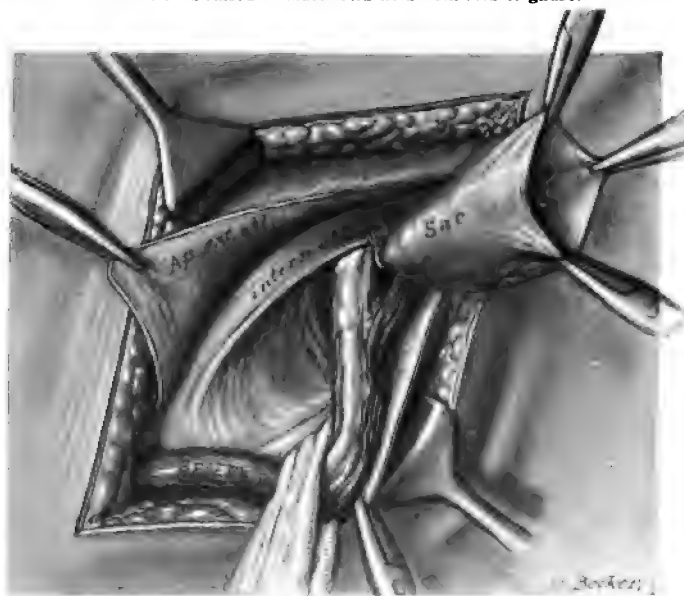


FIG. 810.—BASSINI'S OPERATION, III

Sac dissected from cord, opened, examined, and neck ligatured.

the radical cure of oblique inguinal hernia is the proper suturing of the internal oblique muscle to its tendon and the inner aspect of Poupart's ligament as low

¹ Ferguson: "The Technique of Modern Operations for Hernia," Chicago, 1907.

down as possible without undue tension, after having ablated the sac and strengthened the internal ring with a few stitches above the root of the cord.

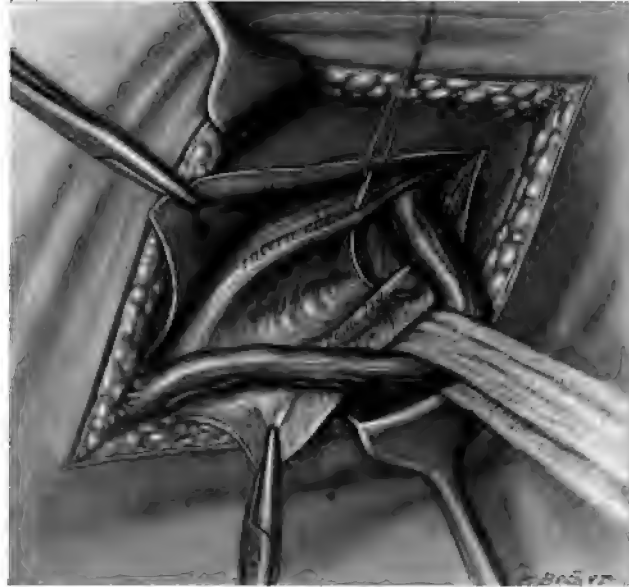


FIG. 811.—BASSINI'S OPERATION, IV.

Sac removed, cord drawn aside, and stitching of lower fibers of internal oblique and transversalis muscle to Poupart's ligament from within outward.



FIG. 812.—BASSINI'S OPERATION, V.

Arched muscular fibers and conjoined tendon sewed to Poupart's ligament.

He makes a curved incision beginning half an inch below the anterior superior process of the ilium, ending near the pubic bone. The superficial fascia is divided

with as little bleeding as possible, the vessels being caught as they are exposed and cut between hemostats. The aponeurosis of the external oblique is freed and the cut is carried through the external abdominal ring and the intercolumnar fascia, with separation of the longitudinal fibers of the external aponeurosis, beyond the internal ring. The sac is opened at its neck, freed of contents, dissected from the cord and internal ring, and either ligated or sutured high up. The cord is not disturbed, though in varicocele complicated with hernia this would be dealt with in accordance with surgical principles.

The cremaster muscle, which is allowed to hug the cord, is reattached to the internal oblique muscle. Fat aggregations should be removed. The internal oblique and transversalis muscles are sutured to the internal aspect of Poupart's ligament, the slack of the transversalis fascia and cremaster muscle being taken up at

the same time. The suturing is extended fully two-thirds down along Poupart's ligament, care being taken to avoid splitting the latter by grasping the same longitudinal fibers in the separate stitches. The conjoined tendon being deficient or absent in the case of direct inguinal hernia, the sheath of the rectus muscle is freely opened to the pubic bone and the muscle brought across the weak part to Poupart's ligament. The aponeurosis of the external oblique muscle is closed by overlapping.

The patient is kept in bed for three weeks and a pad and



FIG. 813.—BASSINI'S OPERATION, VI.
Aponeurosis of external oblique sewed together.

bandage, but no truss, are worn for three months thereafter.

For ligatures and sutures Ferguson uses Nos. 00, 0, and 1 of chromic catgut throughout the operation; No. 1 to tie off the sac, the other sizes for the coaptation of the remaining structures. He states that there has been no return in 2500 patients operated on by different surgeons.

Bassini's operation has for its principle the ligation and removal of the sac, the complete freeing of the cord from its bed, and the suturing of the lower border of the internal oblique muscle and the conjoined tendon to the inner aspect of Poupart's ligament beneath the cord. The latter is then dropped back, the external oblique muscle is closed over it, leaving at the position of the external ring just enough room for the passage of the cord without constriction of its blood-vessels. From 2 to 5 per cent. of recurrences are reported after the operation, mostly in oblique hernias, at the outer angle of the wound. (See Figs. 808, 813.)

It will be noted that the operations described by Bloodgood and Halsted and Ferguson are in many respects alike. All leave the cord undisturbed. All advocate free dissection of the internal oblique muscle and all provide a firm musculofascial wall in the inguinal region. Their methods are simple, easily applicable, and are free from the danger of either thrombosis of the pampiniform plexus or atrophy of the testis. Moreover, the published results as to ultimate cure are as good as those following the Bassini operation, if not better, and these methods have been adopted by men who have given the Bassini method an exhaustive trial.

Surgical cleanliness is the first essential to any form of radical cure. Bloodgood was the first to show the important part played by rubber gloves in the attainment of this end in the treatment of hernia. For the direct inguinal hernias of elderly people appearing as a general prolapse with atrophic muscles and weak fascia, the class of cases in which the operation for radical cure are least promising, Bartlett's¹ successful experience with his silver filigree in ninety-eight cases of abdominal hernia, some of them suppurating, gives promise of a method simple in application and likely to be extremely efficacious. Nor with the silver wire network implanted deeply, in contact with the peritoneum, does there seem to be any tendency for the foreign substance to cause either immediate or remote suppuration.

The proper choice of a ligature material is of scarcely less importance. Catgut which will not be absorbed for at least two weeks is the ideal material. It is open to the objection that in large sizes it is impossible to be assured of its sterility. The small sizes are absorbed too rapidly. Therefore tendon would seem to be the best material to use for buried sutures, since both silk and silver wire remain indefinitely as foreign bodies and may prove foci of suppuration months after operation.

The apposition of structures designed to form a new abdominal wall must be accomplished without tension. This is best furthered by free dissection. The apposition must be accurate.

The avoidance of intra-abdominal tension, particularly when this is associated with the erect position, is desirable for a period of at least two weeks after operation. For six weeks more the area of operation should receive support by a broad compress and a spica bandage, preferably of elastic webbing. A truss may be worn provided it be furnished with a broad flat plate and makes appreciable pressure when there is increase of intra-abdominal tension.

¹ Bartlett, Willard: Personal communication, and "Five Years' Experience with an Original Filigree Intended to Prevent and to Cure Abdominal Herniæ," *Jour. Am. Med. Assoc.*, Sept. 8, 1906, pp. 754-760.

CHAPTER XLII.

THE USE OF DRAINAGE IN ABDOMINAL AND PELVIC SURGERY.

By BROOKE M. ANSPACH, M.D.

History.—The first real adaptation of the principles of drainage to abdominal surgery was made by Peaslee,¹ in 1871. Previous to that time drainage had been unintentionally provided in the operations of ovariectomy and of hysteromyomectomy. In the first it was customary to secure the pedicle by means of a clamp which was left projecting from the wound. In the second there was so much dread of hemorrhage or infection that the sutures securing the cervix were brought out through the incision, or the cervix itself was fastened in the lower part of the abdominal wound.

Peaslee, however, was the surgeon who considered it desirable to drain the pelvis, and who first took measures to that end. Peaslee feared the "red serous fluid" which he had found in the pelvis after death from ovariectomy, and to his mind the stagnation, decomposition, and absorption of it was the source of the fatal septicemia which so often followed operation. This fluid was the result of oozing from the adhesions which had been broken during the enucleation of the tumor, or it represented cyst contents spilled in the pelvis, ascitic fluid left there or secreted after operation, or purulent material from granulating surfaces. In order to prevent accumulations in the peritoneal cavity, Peaslee irrigated the pelvis by means of a catheter introduced through a posterior vaginal or a suprapubic incision, using for this purpose a reservoir bag of a capacity of three quarts, and irrigating until the fluid returned clear. In one case nine quarts were necessary.

The ideas of Peaslee were widely adopted, notably by Sims,² who soon proposed the routine use of drainage. While Peaslee had advised it for cases in which septicemia was especially feared, Sims advocated it as a routine measure, pointing out the fact that the natural drainage point for pelvic operations was through Douglas' pouch.

It was not until Schröder,³ in 1875, drew attention to the rôle played by infection that any argument over the question of drainage occurred. Schröder announced that the "serous red exudate" was harmless, provided no infection had been introduced into the peritoneal cavity during the operation. He reported several cases in which the exudate had occurred followed by recovery.

Nevertheless the principles of drainage prevailed, and many devices were invented

¹ Peaslee, E. R.: "Injections into the Peritoneal Cavity after Ovariectomy," *Amer. Jour. Obst.*, 1871, iii, p. 300.

² Sims, J. Marion: "On Ovariectomy," *N. Y. Med. Jour.*, 1872, vi, Dec. 16, p. 561.

³ Schröder, Karl: "Ueber die Drainage des Douglaschen Raumes bei der Ovariectomie," 1875.

to make it effectual. Köberle's glass tube, Säger's glass tube and wick, and the Mikulicz gauze bag are evidences of the efforts in this direction.

Later on the truth of Schröder's assertion was appreciated by such men as Zweifel, Olshausen, and Czempkin, who objected to all forms of drainage. Olshausen¹ reported that as early as the year 1882 he had abandoned drainage in ovariectomy cases, and that about this time Kocher (quoted by Olshausen) followed the same plan.

The earliest and the most important work in this country was that of Clark,² who reviewed one thousand seven hundred cases of abdominal section observed in Kelly's clinic at Baltimore. This author proved beyond question the uselessness of drainage in most celiotomies for pelvic disease, and pointed out the dangers incident to its employment. He reviewed the histologic and experimental studies of Muscatello, Wegner, Grawitz, Pawlowsky, Waterhouse, Cobbett and Melsome, and others, and introduced a technic which practically applied what was at that time known concerning the function of the peritoneum. Following his work, the limitations of drainage were more generally recognized, and the types of cases in which it was considered good practice steadily diminished.

The last noteworthy occurrence in the history of drainage was the introduction by Fowler³ of a postural method almost exactly opposite to the plan proposed by Clark.

Anatomy and Physiology of Peritoneum, with Especial Reference to Peritoneal Absorption and Localization.—It has been shown by Muscatello, Waterhouse, and others, that the chief area of lymphatic absorption from the peritoneal cavity is in its upper part—through the peritoneum covering the diaphragm and especially about its root. Absorption occurs here much more rapidly than elsewhere, and is aided by elevation of the pelvis. The absorptive power of the peritoneum is enormous, according to Wegner, being 3 to 8 per cent. of the entire body-weight in an hour.

Minute foreign bodies left in the peritoneal cavity are carried up through the diaphragm into the lymphatic duct, thence to the blood and the visceral organs. The minute foreign particles are largely conveyed by leukocytes which have encapsulated or surrounded them. The greater the amount of fluid in which the foreign particles are suspended, the more rapidly does absorption occur. When a foreign body is of such a size that its deportation or absorption is impossible, it becomes an irritant to the peritoneum and is encapsulated by an exudation of fibrin, which glues the intestines or the omentum or both about it, and isolates the foreign body from the general cavity of the peritoneum. The absorptive power from other parts of the general peritoneal cavity is much less than from the diaphragmatic area, and upon this fact both the postural methods of treatment, namely, that of Clark and that of Fowler, depend.

¹ Olshausen, R.: "Die Krankheiten der Ovarien," 1886, Stuttgart, S. 311.

² Clark, J. G.: "A Critical Review of Seventeen Hundred Cases of Abdominal Section from the Standpoint of Intraperitoneal Drainage," Amer. Jour. Obstet., 1897, xxxv, No. 4.

³ Fowler, G. R.: "The Toilet of the Peritoneum in Appendicitis," Trans. Amer. Surg. Assoc., 1903, xxi, p. 23.

Purpose of Drainage.—Peaslee's original purpose in using peritoneal drainage

was to prevent the accumulation of toxic fluids. It appears at first sight that this would be easy enough to secure by providing an exit from the most dependent part of the abdominal cavity and by placing the patient in such a position that peritoneal collections would gravitate in that direction. As a matter of fact, however, any drain so far adopted for the purpose is quickly walled off from the general cavity of the peritoneum, and after a few hours drains only that part which lies immediately in its vicinity. This has been shown repeatedly both by clinical and by experimental investigations. The amount of discharge from the drain is usually directly in proportion to its bulk, and is largely a transudate from the serous surfaces with which it comes in contact. Nevertheless, a properly made and correctly placed drain may be of great service for a limited time, serving to remove infectious products and to direct the flow of toxic fluids externally and prevent their absorption by the peritoneum. But, after four to six hours, the products that are removed by a drain are limited of necessity to those escaping from the areas immediately in contact with the drainage material. Thus the office of a drain changes at the end of about six hours, and it afterward serves merely to encourage the formation of peritoneal adhesions or exudates which shut off the originally drained area from the abdominal cavity. If the drainage material has been properly placed, and if it is allowed to remain for a certain time, these adhesions will safely exclude the infected area.



FIG. 814.—CIGARETTE DRAIN MADE BY ROLLING A PIECE OF RUBBER-DAM AROUND A STRIP OF GAUZE.

If prepared before operation, rubber cement will be needed. If made at the time, a little moisture will cause the rubber-dam to adhere and no cement will be necessary. In all cigarette drains it is important to see that the gauze inlay does not block the rubber sheath.

Distinction between Drainage and Packing.—This leads to a distinction between a drain and a protective pack. Drainage may be maintained for some time from an encapsulated abscess or from a hollow viscus like the gall-bladder. Any other drain after six hours becomes a protective pack. A drain in the peritoneal cavity will be efficient for a short period of time, but after four to six hours it becomes walled off from the surrounding parts, and thereafter simply excites the formation of more encapsulating adhesions or exudates. It is then in a sense no longer a drain, but a device which effectually isolates the area it occupies from the general peritoneal cavity. In many instances this accomplishes the desired end and prevents the spread of an infection.

Materials Used for Drainage and General Considerations.—The efficiency of a drain during the first few hours

depends on the anatomic configuration of the parts, the position in which the

patient is placed, the character of the liquid to be drained, and the material used for this purpose. An ideal drain, therefore, should be conducive to rapid absorption and a minimum of reaction along the drainage tract. A combination of gauze and rubber is the best. This may be either in the form of the cigarette drain, as used by Morris (Fig. 814), or it may be a rubber drainage-tube of large caliber divided spirally throughout its length (Fig. 815) and containing a loose inlay of gauze. After twenty-four to forty-eight hours, the gauze wick may be drawn out, leaving the rubber tube, through which, in a few selected cases, as, for example, an abscess cavity well walled off, gentle irrigation may be practised. One of the best drains can be made from a condom stuffed lightly with gauze and cut open at the end. Fenestrated glass or rubber tubes are objectionable because the fenestra quickly become blocked by the surrounding viscera—bowel, omentum, etc. Glass drainage-tubes should not be used except for a very brief period of time, otherwise they may cause pressure necrosis of the intestine with consequent hemorrhage or fecal fistula. When drainage is indicated after the closure of a hollow viscus, as intestinal anastomosis, cholecystenterostomy, etc., care should be taken that the drainage material causes no pressure on the line of sutures, the drains being placed in the immediate neighborhood, but not in close contact.

Drainage by capillary attraction alone is not very effectual unless the fluid to be drained is thin. Thus, Yates¹ in his experiments found that serum was absorbed rapidly, a slightly albuminous exudate slowly, and pus almost not at all. Capillary drainage will be much more effectual, however, if, as pointed out by Coffey,² the external opening is large. Constriction of the drainage material at the external wound is



FIG. 815.—CIGARETTE DRAIN MADE BY CUTTING A RUBBER TUBE SPIRALLY AND INLAYING A PIECE OF GAUZE. This form is perhaps the most efficient of any cigarette drain.

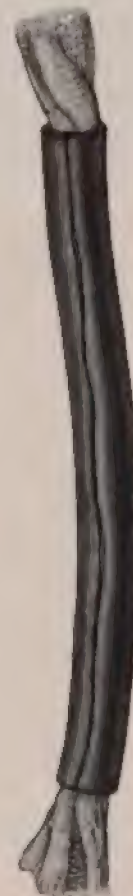


FIG. 816.—CIGARETTE DRAIN MADE BY CUTTING A PIECE OF RUBBER TUBING LONGITUDINALLY AND INLAYING A STRIP OF GAUZE.

¹ Yates, John L.: "An Experimental Study of the Local Effects of Peritoneal Drainage," *Surg. Gynec. and Obst.*, 1905, vol. i, No. 6, p. 473.

² Coffey, R. C.: "The Principles and Mechanics of Abdominal Drainage," *Jour. Amer. Med. Assoc.*, 1907, vol. xlviii, No. 11, p. 937.

not conducive to effectiveness. The exit of the drain should be covered with many layers of gauze, so as to increase as far as possible the capillary attraction, and an effort should be made, either by introducing the drain at the lowest point of the infected area, or by placing the patient in a certain position, or by both, to add the force of gravity.

The extent to which drainage can be used safely is limited by the danger associated with the local reaction it produces. Thus, drainage of a large area may result in numerous adhesions and lead to intestinal strangulation, or the patient may suffer subsequently with severe pain or with nausea and gastric disturbance. Drainage is associated with other risks, being sometimes the portal of an infection. Robb and

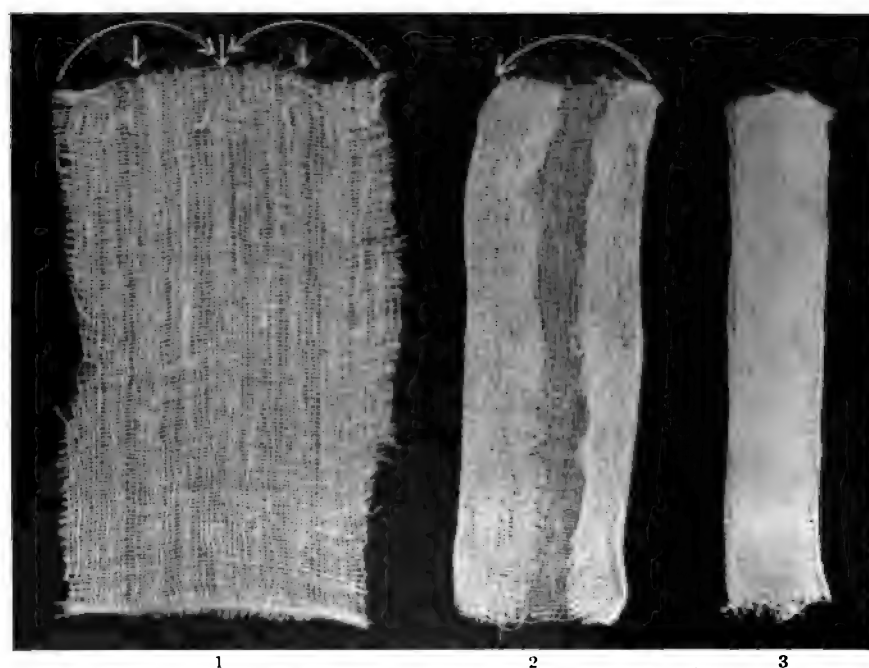


FIG. 817. SHOWING THE METHOD OF MAKING GAUZE DRAINAGE STRIPS.

A piece of gauze is taken 3 yards in length and four times the width of the desired strip and folded as indicated. The two selvage ends are first folded toward the middle line of the strip. Another fold is now made along the median line (2), producing the effect shown in 3. By this method the selvage edges are turned in.

Ghriskey¹ found that notwithstanding the most painstaking efforts to exclude infection drains became the seat of septic organisms in 44 per cent. of cases. A drain also usually prolongs convalescence, gives a certain amount of discomfort, and predisposes to suppuration of the incision, fecal fistula, and ventral hernia.

When is Drainage Required?—It is evident from what has been said that there are reasons for avoiding drainage whenever possible. It has been shown by Waterhouse and others that the peritoneum is able to take care of a certain amount of

¹ Robb, Hunter, and Ghriskey, A. A.: "Infection through the Drainage Tube: the Result of the Bacteriological Examination of Drainage Tube Fluids in Sixteen Consecutive Cases of Celiotomy." Johns Hopkins Hosp. Bull., July, 1891, p. 93.

infection, and that the sooner bacteria and fluids left in the abdominal cavity after operation are absorbed, the less likely is peritonitis to occur. Experimental and clinical evidence of this kind led Clark and others to abandon drainage, with its many disadvantages, and rely on the absorptive powers of the peritoneum to rid itself of infection.

Clark and Norris in addition proved by their experiments that a diluted infection was handled with more rapidity than an undiluted one, and made a practice after laparotomy of leaving a liter of salt solution in the abdominal cavity. This served the double purpose of diluting the infection and of increasing the urinary excretion.

In order to increase absorption through the diaphragm, Clark inaugurated the plan of raising the foot of the bed so as to assist the natural direction of the peritoneal currents by the force of gravity. His plan of favoring rapid absorption by throwing the peritoneal fluid toward the diaphragm has been opposed by many with the objection that in this way an infection which might be kept localized is made general. Likewise, Fowler, Coffey, and others doubt the wisdom of emptying into the general circulation a great quantity of toxic substances, and question the ability of the resistant forces of the body to successfully cope with them. Exemplifying this doubt Fowler advocates a sitting posture in order to keep infectious products in the least absorbing part of the peritoneal cavity until they can be encapsulated or removed.

Careful consideration shows that of necessity there must be a difference between the views of the gynecologist and the abdominal surgeon. A majority of purulent collections in the pelvis are due to the gonococcus, an organism which is little disposed to attack the general peritoneum. Non-puerperal pelvic infections so commonly become walled off from the general peritoneum that operation is delayed until the acuteness of the infection has subsided. At the time of operation the pus is feebly infectious or even sterile, soiling of the operative field is of little moment, and a careful cleansing is all that is required.

When the pelvic infection dates from abortion, labor, or operative manipulation, it less often becomes innocuous, and the danger of peritonitis from intra-abdominal manipulation is greatly increased. Therefore the vaginal route for operation, drainage through the vagina, and Fowler's position become advisable in order to lessen the risk of infecting the general peritoneum.

Acute infections of the appendix, the gall-bladder, the stomach, and the pancreas are again virulent in type and less likely to localize, so that drainage will be required oftener than after operation for old inflammatory lesions of the pelvis.

In appendicitis complicated by purulent collections, for example, it is difficult to know when to omit drainage. Westbrook² has said: "While it is true that the peritoneum may be relied upon to take care of a certain quantity of infectious material, we do not know in any individual case what that quantity may be. An estimate of the individual's comparative resistance is possible, but there is no means of

¹ Clark, J. G., and Norris, C. C.: "Peritoneal Saline Infusions in Abdominal Operations," *Jour. Amer. Med. Assoc.*, Jan. 30, 1904, p. 281.

² Westbrook, R. W.: "The Question of Drainage in Appendicitis with Outlying Appendical Infection," *Brooklyn Med. Jour.*, Feb., 1902, xvi, 88.

exactly determining at the time of the operation the amount and the virulence of the infection. If the surgeon decides to omit drainage in a case of appendicitis with outlying infection, he must do so relying entirely upon his personal ability to gage the clinical facts in the case and the nature and the extent of the pathologic process exposed at operation."

While it is difficult, and often impossible, in abdominal or pelvic inflammation to correctly estimate the severity of the infection, it should always be the surgeon's desire to note every clinical fact in the case which tends to throw any light upon this question. Certainly, clinical evidence has shown that pelvic infections following abortion, labor, or instrumental manipulation of the uterus are more violent than other pelvic infections, and, consequently, should be drained much oftener, and even, it might be said, as a rule. In cases of inflammation of the appendix, the gall-bladder, and the pancreas, with an outlying peritoneal involvement, it is safer to use a limited amount of drainage in the majority of cases, and by this means assist the peritoneum in disposing of the infectious material.

General Technic of Intraperitoneal Operations in Cases of Infection.—In operating on any intraperitoneal organ where an infected area or collection is known to exist or is suspected, the surrounding intestines should be pushed to one side and an abundant gauze barrier placed between the diseased organ and the general peritoneal cavity. After the offending part has been removed, the peritoneal surface in its immediate neighborhood should be cleaned by sponges wrung out of salt solution. If drainage is indicated, the drains are placed in position before the protective layer of gauze shutting off the general peritoneum is taken out.

DRAINAGE OF PARTICULAR ORGANS OR PARTS.

Uterus.—Drainage of the uterus may be required after operation for septic endometritis and metritis following labor or abortion, retained and decomposing products of conception, sloughing intrauterine growths, pyometra, hematometra, etc. The cervix must be thoroughly dilated. The end of a gauze strip is carried to the top of the endometrial cavity and the uterus is *lightly* filled with gauze, especial care being taken that there is no blocking of the cervical canal.

Pelvic Peritoneum and Uterine Adnexa.—Drainage is not required after most celiotomy operations for non-puerperal pelvic inflammatory disease, the pus often being sterile or weakly infectious at the time the operation is performed. In addition, the intestines and the abdominal cavity can be walled off with gauze, and any pus which escapes during the operation can be sponged away without endangering the general peritoneum. After completing the intrapelvic procedure, the pelvis should be painstakingly cleaned, before the protective barrier of gauze is removed and the intestines and the omentum are allowed to fall into the pelvis.

That the infrequent use of drainage after celiotomy for pelvic disease is justified is indicated by the work of Olshausen,¹ who employs drainage in very exceptional

¹ Olshausen, R.: "Wider die Drainage," Zeit. f. Geburtsh. u. Gynäk., 1903, Bd. xlviii, S. 305.

instances only. The propriety of drainage, he thinks, would be questioned especially in four classes of cases:

1. When pus or necrotic material has been spilled during the operation into the peritoneal cavity.
2. When a malignant tumor cannot be fully extirpated, or when an infiltrated abscess wall is left behind.
3. Penetrating wounds of the intestine or the bladder.
4. Operations which may be characterized as unclean, in which a large quantity of fluid must remain in the peritoneal cavity. Examples of this are found in large ovarian tumors when some of the contents is spilled into the peritoneal cavity; in pseudo-myxoma peritonei; and in old hematoceles.

In all these cases Olshausen makes as careful a toilet of the peritoneal cavity and pelvis as possible and then closes the incision without drainage. In one thousand five hundred fifty-five celiotomies performed by him in six years, there were one hundred fourteen in which he considered the advisability of drainage, but did not use it. Sixty-five of these belonged to the first class and resulted in fourteen deaths; ten belonged to the second class—one death; twenty belonged to the third class—seven deaths; eighteen belonged to the fourth class—one death.

While admitting that the mortality of the one hundred fourteen cases was not low, Olshausen draws attention to the fact that they were the most serious ones of the entire one thousand five hundred fifty-five. The mortality in the first group was high because in eight cases multiple peritoneal abscesses complicated a fresh peritonitis; and in the third class there were fifteen cases of perforation of the intestine with seven deaths.

The practice of Olshausen is amply justified by the results he has achieved, except in two series of cases, namely, those complicated by multiple peritoneal abscesses, and those complicated by intestinal or vesical injury. In both of these conditions drainage is advisable.

In pelvic surgery experience has shown that drainage is indicated under the following instances:

When the small intestine, the rectum or the sigmoid has been injured in the separation of adhesions and there is any doubt as to the security of the sutures closing the rent.

When a large amount of exudate or a considerable portion of an abscess sac must be left behind.

To favor hemostasis and to provide free exit in case of extensive oozing.

Pelvic drainage is made by preference through Douglas' pouch. At the conclusion of the celiotomy, the pelvis is thoroughly cleansed by sponging with moist gauze, or by irrigation and dried with gauze pads. A few coils of gauze are then packed into Douglas' pouch, and the abdominal incision is closed. The patient is placed in the lithotomy position, the vagina and the external genitalia are thoroughly disinfected, and an opening is made into the pouch of Douglas by incising the posterior vaginal wall (Fig. 818). Through this the gauze is drawn and an abundant

perineal dressing is applied externally. In the case of *pelvic inflammatory disease which follows abortion or labor, or is associated with extrauterine pregnancy*, the infecting organism is more often virulent than in cases unconnected with pregnancy. Cases of this sort, I believe, should be preferably operated upon through the vagina. If an abdominal operation is imperative, great pains should be taken to protect the general peritoneal cavity, and drainage should always be provided through Douglas' pouch.

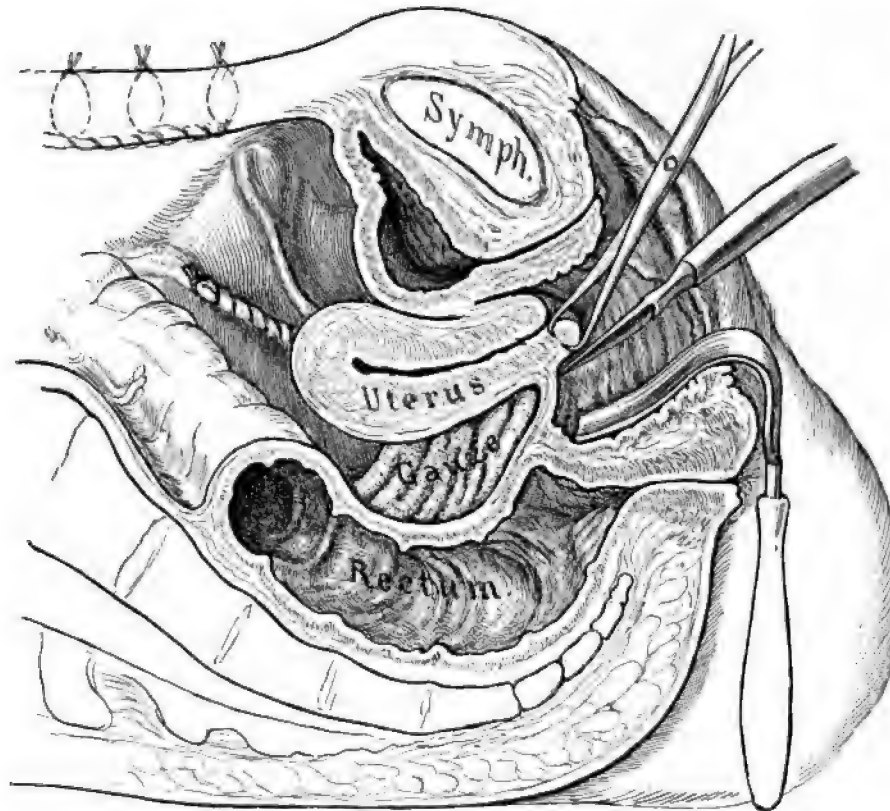


FIG. 818.—THE INSTITUTION OF DRAINAGE THROUGH A POSTERIOR VAGINAL INCISION.

The operation through the abdominal incision has been completed. A strip of gauze is coiled in Douglas' cul-de-sac, and the celiotomy wound closed. The patient is placed in the dorsal position, the posterior vaginal wall is retracted, the posterior lip of the cervix is pulled upward and forward, and an incision is made into the pouch of Douglas. The opening should be dilated and the end of the gauze strip drawn into the vagina. Care must be observed that the posterior vaginal opening is free, and is not blocked by the drain.

After the *vaginal incision of a pelvic abscess* or a hemocele in Douglas' pouch, the posterior vaginal opening is dilated and the cavity is snugly filled with folds of gauze. When pelvic drainage is indicated after panhysterectomy, either by the abdominal or by the vaginal route, it may be placed through the opening in the vault of the vagina. Drainage of this sort should not be disturbed for from three to five days; in the meantime no vaginal douches are permissible, and the ostium vagina is constantly protected with a sterile dressing.

Vermiform Appendix.—After appendicectomy for acute inflammatory lesions when there is *no abscess formation, but the intestine surrounding the appendix is red and injected and covered with flakes of lymph*, it is advisable, observing the precautions respecting the general peritoneum already described, to introduce several cigarette drains, either through the original or through a lumbar incision, as may be most convenient. An *appendiceal abscess securely walled off from the general peritoneum* should be opened by an incision which does not invade the general peritoneal cavity. After evacuation the sac should be drained by a cigarette drain made of rubber tubing with a gauze inlay.

When an abscess cannot be reached *extraperitoneally*, before evacuation the surrounding areas must be well protected. The appendix is looked for, and removed if readily found; no prolonged search or dissection, however, should be made for it. The surfaces which formed the wall of the abscess sac should then be dried, and if not too extensive or inaccessible wiped with a formalin (1:500) or a bichlorid (1:500) solution; smaller areas should be touched with pure carbolic acid, followed immediately with alcohol. The drain should be placed in position before removing the gauze which protects the general peritoneum. The drain may often with advantage be brought out through a stab wound in the loin, directly above the crest of the ilium and an inch and a half behind the anterior superior spine. This incision is most suitable for cases in which the area to be drained lies to the right of the colon or beneath it. If the infected area lies to the inner side of the colon or near the pelvic brim, one drain should be brought out through the incision and another should be placed through a suprapubic incision to the bottom of the pelvis. When an abscess has actually invaded the female pelvis, it should be drained by an incision through Douglas' pouch. A pararectal² or a rectal incision has been recommended in

¹ Deaver and Ross (Deaver, John B., and Ross, Geo. C.: "The Mortality of Appendicitis," Jour. Amer. Med. Assoc., vol. xxxvii, p. 1898) give the following as the most common positions of appendiceal abscess:

1. Behind the cecum and between the layers of the mesocolon. This is the most common and is attended by a high rate of mortality, because of the tendency to gangrene and necrosis of the cecum from an interference with its blood-supply, post-peritoneal infection, lymphadenitis, phlebitis, and pylephlebitis.

2. Immediately beneath the parietal peritoneum confined by the cecum, the coils of the small intestine, the omentum, the appendix, the peritoneum, and a mass of inflammatory lymph. In this variety the mortality is much lower, and the question of removing the appendix arises most often.

3. Pelvic collections of pus. This is a most favorable location, but it is frequently unsuspected or overlooked.

4. Near the median line and to the mid-line of the cecum. A fatal issue is exceedingly likely. This variety is most apt to be connected with secondary collections, and it is difficult and frequently impossible to treat such an abscess without infecting the general peritoneum.

5. The infection is free in the general peritoneal cavity, and practically all such cases are fatal unless operation is performed very early.

² E. M. Sutton: ("Peritoneal Operation for Perforative Appendicitis with Abscess in the Cul-de-sac," Jour. Amer. Med. Assoc., vol. xxx, June 18, 1898, p. 1438) describes the plan he used for draining an abscess of the pelvis in a male. A horseshoe incision was made, beginning at a point mid-way between the tuber ischii and the anus, extending to the bulbous portion of the urethra, and from there to a similar point on the opposite side. The external hemorrhoidal nerve and artery were pushed back, and the transversus perinei, with the bulbous portion of the urethra, were pushed forward. The fibers of the external sphincter were incised transversely at their junction with the bulbo-cavernosus muscles. The deep fascia was also incised transversely where it dips down to join the pelvic fascia, separating the levator ani muscle, reaching the prostate and pushing it forward, and continuing the dissection back and up to the cul-de-sac.

persons of the opposite sex, but in most cases is inadmissible for several reasons.



FIG. 819.—DRAINAGE OF THE GALL-BLADDER.

A piece of rubber tubing is secured by means of a catgut suture to one of the edges of the incision in the gall-bladder.

is to use a mushroom catheter (Fig. 550), which can be maintained in position without being sutured, and removed at any time. Irrespective of the one selected, care should be taken by means of suitable stitches to close the incision in the gall-bladder snugly, but not tightly, about the drain (Fig. 821), inverting the cut edges so that the serous surfaces are in apposition. The gall-bladder is closely sutured also to the parietal peritoneum, but not to the muscle or fascia of the abdominal wall. The catheter or the tube should be long enough to project 7 or 8 inches beyond the abdominal incision, and at its outer extremity another piece of tubing should be attached, by means of a glass connection, and carried over to a glass receptacle suspended at the side of the bed. By this means, the rate and quality of the discharge may be constantly observed, there is practically no soiling of the incision, and the patient is much more comfortable. If the gall-bladder has been infected, it is useful, after several days, to gently irrigate through the tube with a weak solution of protargol, 10 per cent., or nitrate of silver, 1:3000.

A rectal incision is objectionable on general principles and in certain cases must add an element of danger from infection. In exceptional cases an appendiceal abscess occupying the pelvis has been successfully opened and drained through the rectum.

A pararectal incision, unless carefully performed, is capable of much harm, and because of the time it would consume would be entirely unjustifiable. Few surgeons would jeopardize the life of an already desperately sick patient in order to drain the pelvis in this way. A better plan is to assist the action of supra-pubic drainage by rectal massage at regular intervals.

Whatever exits are chosen, the incision should be free, and care should be taken that the drainage material does not block it.

Gall-bladder and Gall-duct.—*It is always advisable to drain the gall-bladder after cholelithotomy.* The usual way is by means of rubber tubing held in place by a catgut stitch, which is absorbed by the time drainage is no longer desirable. A better plan



FIG. 820.—DRAINAGE OF THE GALL-BLADDER.

The edges of the incision are inverted and united above and below the tube by means of a running catgut suture.

If the *gall-bladder is infected or the surrounding parts have been soiled*, several cigarette drains should be placed in the wound below its attachment to the gall-bladder. These should reach the foramen of Winslow and the renal fossa on the right side.

After *simple choledochotomy* the incision in the common duct should be neatly closed and drainage provided through the gall-bladder. A cigarette drain, however, should always be placed below the line of sutures in the common duct. When for any reason the presence of small calculi in the hepatic duct is suspected, rubber tube drainage of the hepatic duct should be instituted.

Kehr's¹ technic for drainage of the hepatic duct is as follows: After the stones have been removed a soft-rubber tube is inserted through the common duct incision upward into the hepatic duct. Sometimes the bifurcation of the hepatic duct is so low down that the tube can be introduced for only a short distance. A catgut suture is used to fasten the tube into place. Gauze wicking is placed about the tube, and neither are disturbed for two weeks. Before that time, according to Berger, bile will be flowing freely into the intestine.

The importance of draining the gall-bladder after an operation on the common duct has been noted by Coley.² He agrees with Quénu that the common duct should never be sutured unless the gall-bladder is drained, and indorses Robson's plan of suturing the duct and draining the bladder as the ideal form of procedure. The Mayos³ say that it is quite unnecessary, as a rule, to suture the common duct or to introduce a rubber tube for the purpose of draining the hepatic duct. Instead they provide drainage for the common duct incision and drain the gall-bladder, except in the simplest cases.

HEPATIC DRAINAGE WHEN THE BILIARY TRACT IS INFECTED.—Deaver⁴ remarks that hepatic drainage must be provided in all infected cases, through the gall-bladder, the common duct, or the hepatic duct.

Abscess of the liver is prevented and pancreatitis is relieved by prompt drainage. Bile is always to be regarded as a septic fluid, capable of causing peritonitis. After choledochotomy, even though there is no clinical evidence of infection, and it is certain that suture of the incision will not constrict the lumen of the duct, drainage of the area should be provided, for fear of leakage.

¹ Berger, Erich: "Die Hepaticusdrainage," *Archiv f. klin. Chirurg.*, 1903, Bd. lxxix, S. 299.

² Coley, W. B.: "Progressive Medicine," 1899, p. 61.

³ Mayo, W. J.: "A Study of 534 Operations on the Gall-bladder and Bile Passages," etc., *Boston Med. and Surg. Jour.*, 1903, vol. cxlviii, p. 545.

⁴ Deaver, John B.: "Hepatic Drainage in Infection of the Biliary Tract," *N. Y. Med. Jour.*, 1904, vol. lxxix, p. 147.

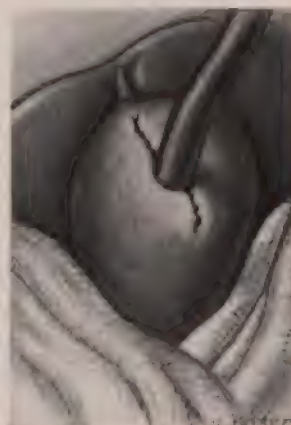


FIG. 821.—DRAINAGE OF THE GALL-BLADDER.

The institution of drainage completed and the margin of the gall-bladder incision united above and below the tube, so that the serous surfaces are in apposition. The catgut suture holding the tube in place is absorbed at the end of two weeks and the tube may then be readily removed. All of these sutures should be of catgut preferably.

The best method of draining the common and hepatic ducts is that employed by Martin and Carnett. A rubber tube of suitable length is bisected for the distance of an inch at one extremity. The two flaps thus formed are bent backward on the tube at right angles and secured in this position by a stitch which embraces the angle. The tube is now introduced into the common duct, one of the flaps being passed into the duct above and the other below the incision. By this plan the lumen of the common duct is practically unobstructed, and the bile takes its normal course or comes out through the tube.

DRAINAGE WHEN THE CYSTIC DUCT IS OBSTRUCTED OR THE GALL-BLADDER HAS BEEN REMOVED.—If the cystic duct is obstructed, the gall-bladder is excised and a drainage-tube is inserted into the end of the cystic duct. If the gall-bladder has been previously removed, the stump of the cystic duct is opened. In case none of the cystic duct remains, or if it is so diseased that it is more or less impervious, drainage of the hepatic duct should be inaugurated.

Stomach.—Most of the operations on the stomach require no drainage. After operation for a penetrating wound, it is advisable, usually, to insert a strip of gauze down to the line of suture. If the wound is clean-cut and there is but little bruising of the surrounding wall, this may be omitted.

Following operation for a perforating ulcer, drainage will be indicated at the site of the lesion and elsewhere, if there has been extensive soiling of the peritoneum. Drainage may not be required if the case is operated on within six hours. When twelve hours have elapsed, however, it is safer to make use of it.¹

Pancreas.—Drainage should be employed in connection with every form of surgical operation on the pancreas. The only exceptions to this rule, according to Moynihan, are cases in which no pancreatic fluid has escaped during the procedure and the peritoneal incision used to expose the pancreas has been closed by suture.

General Peritoneum.—Nearly all surgeons agree that drainage is a necessity in general peritonitis. There is some difference of opinion, however, as to the extent to which it should be employed. The condition of the patient must be the guide to the amount of operative manipulation. In the most serious cases when general anesthesia is undesirable an incision should be made under local anesthesia, the original site of infection should be removed if possible, a gauze and rubber drain of large caliber should be placed in the wound and an additional one inserted to the bottom of the pelvis. When the condition of the patient permits, it is advisable to wash out the general peritoneal cavity and introduce drainage at several points. The original site of the infection should be drained through the primary incision, if the latter is made directly over it. If the first incision lies at some distance, a second one is required.

There are certain areas in the abdominal cavity where fluids are apt to collect, and pains should be taken to provide efficient drainage for them (Fig. 822). An incision in the flank on both sides will be required to drain the renal fossæ. In

¹ Moynihan, B. G. A.: "Abdominal Operations," p. 116, Phila. and London, 1905.

² Loc. cit., p. 596.

the female the pelvis is readily drained through the pouch of Douglas. In the male cigarette drains may be introduced to the bottom of the pelvis through a low median abdominal incision. The head of the bed should be elevated to favor the flow of septic material toward the pelvis.

The treatment of general peritonitis is so disappointing in its results, and the limitations of any form of drainage are so manifest, that some surgeons use no more than a comparatively small drain in the original incision. Blake,¹ in 1903, reported



FIG. 822.—ABDOMEN SHOWING THREE MAJOR FOSSÆ, RIGHT AND LEFT ABDOMINAL, AND PELVIC. The abdominal fossæ are subdivided into renal and iliac. In these fossæ fluids are prone to accumulate with the patient in recumbent position.

a series of general peritonitis cases, some of which were treated with drainage and some without it. Although he admits that sweeping conclusions cannot be drawn because the series was small, it is of some significance to note that there were about an equal number of recoveries in the two classes, the advantage even resting slightly with the undrained cases. He says: "I was formerly a warm advocate of abundant drainage; later, I became convinced of the utter impossibility of draining every part

¹ Blake, Jos. A.: "The Treatment of the Peritoneum in Diffuse Peritonitis," *Trans. Amer. Surg. Assoc.*, 1903.

of the peritoneal cavity, for it was evident that the drain was soon isolated by adhesions; so I next confined myself to the drainage of the field of operation; and then perceiving that the other similarly affected regions of the peritoneum took care of themselves, I omitted drainage almost entirely and only employed it when the presence of a non-absorbable amount of necrotic tissue or hemorrhage demanded it."

Although Fowler¹ uses drainage in the great majority of cases, he says: "I would also state that there are certain cases of diffuse septic peritonitis which may be safely closed without drainage. These are cases in which there are no necrotic areas, and in which the serous covering of the intestine is not blistered or desquamated or swollen or infiltrated. It is my firm conviction, however, that cases for complete closure should be carefully selected, and can only be safely selected by an operator of wide and constant experience. No more striking evidence could be adduced in support of drainage than the frequency with which secondary abscesses form in these desperate cases. They do not form because of the drainage, but in spite of it, and often can be easily opened through the drainage tract."

Blake² has recently reported a series of ninety-nine cases of diffuse suppurative peritonitis; seventy-eight followed appendicitis; the mortality was 19.27 per cent. Of fifteen who died, seven were not drained; eight were drained. Of the patients who recovered, thirty-one were not drained, twenty-eight were drained to the stump of the appendix, and four were drained to the pelvis. The author also reports thirteen cases of diffuse peritonitis, caused by perforation of the stomach or of the upper intestine. There were four deaths, a mortality of 30.7 per cent. Of the four patients who died, two were not drained and two were drained to the suture line. Of the nine recoveries, four were not drained, and four were drained from the suture line of the stomach, and one was drained from the pelvis. In eight cases of diffuse peritonitis following perforation of a typhoid ulcer, four died and all four had been drained. Of the four recovering, drainage was employed in two.

Blake's principles of operative treatment in such cases are:

1. To remove the origin of the inflammation as rapidly as possible through a small incision.
2. To wash out and irrigate the peritoneal cavity.
3. To use as little drainage as possible and not to attempt to drain the general peritoneal cavity.

In estimating the value of Blake's comparison of drained with undrained cases, it should be stated that he invariably drains the wound. The small drain which he uses for this purpose evidently projects slightly into the peritoneal cavity beneath the incision, so that, to some extent at least, drainage is used in all of his cases, and the incision is never tightly closed.

He says: "It is my impression that our patients have made smoother recoveries

¹ Fowler, R. S.: New York State Jour. of Med., Oct., 1907, p. 401.

² Blake, Joseph A.: "The Treatment of Diffuse Suppurative Peritonitis," Amer. Jour. Med. Sci., March, 1907, cxxxiii, 454.

by the omission of drainage when possible, and I cannot look back with regret upon the occasions when I have omitted it. On the other hand, it is impossible to draw hard and fast lines as to the method of treatment in these cases, and judgment must be continually exercised. Some need drainage, some do not. Some seem to do better with irrigation, others get well without irrigation or drainage, and some die whether drained or not, washed or unwashed."

The treatment of a case preparatory to the institution of drainage is also a moot point. Finney¹ advised, practised, and finally abandoned eventration of the intestines with thorough cleansing of the peritoneal cavity and the loops of bowel with gauze and saline solution. The worst coil of bowel was replaced last, left near the incision, and packed about with strips of gauze. He did not think favorably of irrigation under all circumstances. Most surgeons believe in irrigation without evisceration. Among those who have expressed themselves as favorable to this plan may be mentioned McCosh² and Dwight,³ the latter reporting a series of thirty-five cases with fifteen recoveries. Dwight believes in irrigating until the solution returns clear, and then placing three or four gauze drains in different parts of the abdomen.

Murphy,⁴ of Chicago, reports forty-eight consecutive operations for general suppurative peritonitis resulting from a perforation in some part of the gastro-intestinal tract. There were two deaths; one from double pneumonia on the sixth post-operative day, another from intestinal obstruction four and one-half days after the operation. Drainage and continuous enteroclysis were used in all.

In the discussion of a paper which he read before the American Association of Obstetricians and Gynecologists in 1906,⁵ he said that he considered an early operation the precious element in the treatment of these cases. If the patient has received a sufficient dose of toxins, death will occur no matter what procedure is adopted. Nothing but a timely operation will prevent this intoxication. Murphy avoids handling the intestines and the viscera as much as possible. He closes the perforation wherever it may be, and introduces drainage after the method of Fowler.

Continuous enteroclysis is a most valuable addition to the after-treatment. For this purpose the ordinary vaginal douche tip with three openings should be used, so that the water can flow in through one and the gas pass out through the others. If a tip with a single opening is used, gas will not bubble back into the reservoir. The evacuation of gas in this manner is important; otherwise when the patient attempts to expel the gas through the anus the salt solution will not be retained.

The elevation of the reservoir should be from four to six inches above the level of the anus. The nurse should be instructed to watch the patient closely and not

¹ Finney, J. T. M.: "Surgical Treatment of Perforating Typhoid Ulcer," *Ann. Surg.*, 1897, xxv, 233.

² McCosh, Andrew J.: "The Treatment of General Peritonitis," *Medical News*, 1905, lxxxvii, 865.

³ Dwight, Ed. W.: "General Purulent Peritonitis, with a Report of Thirty-five Cases, of which Fifteen Recovered," *Med. and Surg. Reports Boston City Hosp.*, 1902, p. 88.

⁴ Personal Communication.

⁵ Murphy, John B.: *Trans. Amer. Assoc. Obstet. and Gynecol.*, 1906, vol. xix, p. 183.

allow any more than one and one-half pints of the saline solution to be introduced during forty minutes to one hour. The rubber tube connecting the douche tip and the reservoir can be strapped to the leg of the patient with adhesive plaster, the reservoir being suspended at the head of the bed and kept warm with a hot-water bottle. (See Fig. 622.)

There need be no irritation of the rectum, and the patient often goes to sleep while the irrigation is being carried on. The tube is not taken out for days. The rate of flow is not controlled by compressing the tube with forceps, but by the degree of elevation of the reservoir.

The abdominal drains are kept in place until there is a cessation of the discharge. The length of time varies considerably in different patients. It may be a week, it may be considerably longer.

Among the best results which have been reported are those of the Fowlers. They believe in irrigation, drainage, and the use of a semi-recumbent position, which has been given their name. The Fowler position¹ causes peritoneal fluids to gravitate to the pelvis, and antagonizes absorption in the diaphragmatic area. The large stomata of the peritoneum covering the diaphragm favor the transference of septic peritoneal fluids in its vicinity to the circulation, with resulting distant infection, or general intoxication, or both. On the other hand, the gravitation of septic fluids to the pelvic cavity results in an environment unfavorable to their absorption. The anatomic peculiarities of the pelvic peritoneum are such that, as is well known, "septic conditions of the most pronounced character may exist for a long time without grave danger to the individual."

In 1904 a report was made of one hundred cases of diffuse septic peritonitis treated by the Fowler methods, with a recovery of 67 per cent.²

Another report was made in 1907.³ One hundred and forty-four cases were reported; there were 59 per cent. of recoveries. These results are strikingly good, and prove, I believe, that *for the majority of cases of diffuse peritonitis the following plan of treatment is the best:*

1. A small incision and the avoidance of eventration.
2. The removal, if possible, and a thorough cleansing of the primary focus of infection.
3. The evacuation and cleansing of all accessory cavities and the pelvis before washing out the peritoneal cavity.
4. A rapid systematic flushing of the peritoneal cavity with peroxid and soda solution (peroxid of hydrogen and a saturated solution of bicarbonate of soda, equal parts) followed by hot saline solution.

¹ Fowler, G. R.: "The Toilet of the Peritoneum in Appendicitis," Trans. Amer. Surg. Assoc., 1903, xxi, 23.

² Fowler, R. S.: "Results in Diffuse Septic Peritonitis Treated by the Elevated Head and Trunk Position," Med. News, May 28, 1904.

³ Fowler, R. S.: "The Treatment of Diffuse Septic Peritonitis Following Appendicitis," New York Jour. of Med., vol. vii, No. 10, Oct., 1907, p. 401.

of the saline flushing until the sutures are placed and for

of proper drainage for the pelvis, either by means of a large capillary drainage strip emerging through the lower angle in the female by a large-caliber rubber tube filled with wicking posterior colpotomy incision.

age of accessory abscess cavities with gauze or wicking.

tion of the head of the bed to accelerate the drainage of septic fluids

of the bed is elevated, 7, 13, or 20 inches; the lowest elevation is used in the first few hours; after that the highest, except in cases of nervous shock. In the highest elevation of the head of the bed, the patient is prevented from slipping forward by a folded pillow placed against the buttocks and held there by a stout bandage passed through the fold of the pillow and tied at the head of the bed. In this way the knees are flexed on the abdomen and the abdominal wall is relaxed, adding to the comfort of the patient. A saline enema is repeated four to six times at three- to four-hour intervals or continuous enteroclysis according to Murphy's plan (page 727) should be used. If gas is not passed freely by the bowel, a high enema of turpentine and ox-gall is used. Fluids are given by the mouth *ad libitum*. The drainage-tube is dressed separately with a hood of rubber dam, and its contents are evacuated and fresh gauze applied every four hours.

In making an estimate of the value of drainage and the various plans of treatment of diffuse peritonitis, it must be kept in mind that all cases spoken of as general peritonitis are by no means alike, either in extent, form, or cause. A really general peritonitis involves the entire peritoneal cavity, including that of the lesser omentum. Deaver drew attention to this fact in 1898, and Hartley, in 1899, expressed the same opinion. "Many cases," Deaver says, "are reported in the literature as recoveries from general purulent peritonitis, but from my experience I am led to think that there was probably some error in the diagnosis and that the cases were probably a very extensive, but nevertheless a localized peritonitis."

In order to secure an accurate idea of the comparative value of different plans of treatment, it would be wise in reporting them to divide peritonitis cases into the three classes suggested by Blake. They are: (1) An abscess with limiting adhesions. (2) A spreading peritonitis in which there is no actual localization of the process by adhesions or gravitation, but in which there are ascertainable limits to the infection. (3) Cases of general peritonitis in which no part of the peritoneum, possibly excepting the lesser sac, can be demonstrated as free from the invasion.

Whatever treatment is adopted, should be selected for the individual case. While in one instance no more than a hasty incision and the introduction of a drainage-tube may be permissible, in another the most elaborate technic of disinfection and drainage would be justified.

Kidney.—A paranephric abscess demands free drainage. After nephropexy

and aseptic cases of nephrotomy or nephrolithotomy when the kidney incision is clean-cut and can be nicely approximated no drainage is required. If the incision is ragged the paranephric tissues should be drained. When infection is present and when it is desirable to drain the pelvis because of obstruction, cigarette drains of rubber tubing and gauze should be introduced through the kidney incision as far as the pelvis; at the same time several cigarette drains should be placed in the paranephric areas.

After ureterotomy for stone or stricture, a drain should be passed to the neighborhood of the line of sutures.

Bladder.—Drainage of the female bladder is required after operation for vesical stone and fistula, and is readily accomplished by the introduction of a self-retaining (mushroom) catheter through the urethra.

If the bladder is highly inflamed and complete and constant drainage is desired, the organ should be opened at its base by an incision through the anterior vaginal wall. The vesicovaginal fistula thus made is maintained by the introduction of a mushroom catheter or by uniting the vesical to the vaginal mucosa.

Suprapubic vesical drainage is often required in the male, and on some unusual occasions might be desirable in the female. A rubber tube should be secured in the vesical incision and connected with a glass receptacle at the side of the bed in the manner described for drainage of the gall-bladder. In such cases it is usually advisable to place one or two cigarette drains in the space of Retzius.

Intestine.—In certain cases of ileus when the patient is so ill that an operation for permanent relief cannot be undertaken, the bowel should be drained above the seat of obstruction. After suturing the intestine at this point to the parietal peritoneum and making an enterotomy incision a rubber tube should be passed into the bowel and held there by a purse-string suture in the outer intestinal coats and one transverse suture which passes through the tube. The outer extremity of the rubber tube should be conducted over the side of the bed to a suitable receptacle. After the symptoms have been relieved and the patient is stronger, an operation to relieve the obstruction may be undertaken; at that time the enterotomy incision should be closed.

POST-OPERATIVE CARE OF DRAINAGE.

Gauze packing introduced for the purpose of controlling hemorrhage should be removed within twenty-four to thirty-six hours. Uterine drains should be removed at the end of twenty-four to thirty-six hours.

Other gauze drains should not be disturbed until the fifth post-operative day. There are some exceptions to this rule; for example, if the drain is quite superficial or if it is a question whether there is any infection and the necessity for its original use was a matter of doubt, the gauze may be removed at the end of twenty-four to thirty-six hours.

Cigarette drains may be taken out earlier than drains composed entirely of gauze, because there is less danger of breaking up protecting adhesions.

be maintained for a comparatively longer time if tissue has been left in the operative area. Such drains, whatever their position for at least five days and then be slowly removed. Each day without using force, so that the material is extracted from its attachments. Painstaking asepsis is required in all drains. After the fifth day the gauze may be moistened with sterile solution for its removal. Solutions should never be injected into the drainage. In the case of an encapsulated collection, when it may be useful to have a regular drainage. The use of peroxid of hydrogen in abdominal drainage is dangerous. For cleansing purposes nothing is more efficient than salt

In cases of pancreatitis or infection of the biliary ducts it is desirable to maintain drainage until the symptoms of the trouble have entirely disappeared and the bile is sterile.

When nephrotomy or nephrolithotomy has been performed primarily and there is an obstruction of the ureter to be overcome at a second operation, drainage should be continued until the symptoms of infection and inflammation have subsided.

CHAPTER XLIII.

THE SURGERY OF THE URETER.

By HOWARD A. KELLY, M.D.

The surgery of the ureters is a growth of the past two decades. Prior to that period, the one commonly recognized ureteral malady was a fistula opening into the vagina, and the only sure plan of treatment was a nephrectomy. Today, thanks to the labors of a galaxy of contemporary surgeons, the surgery of the ureters stands on a plane which for completeness of conception and technic can be compared favorably with the surgery of any other individual organ in the body.

The reason for the remarkable growth of this delicate branch of the surgical tree lies not so much in a minuter exploration, nor in the discovery of new pathologic affections of the organ, as in the fact that the conditions which oftenest call for relief are those which have been created by the hands of the surgeon himself. In other words, as abdominal surgeons have become more and more active and aggressive, injuries of the ureters have followed *pari passu*.

With the first advances in abdominal surgery, within the last two decades,—and by advances I mean not so much the invention of new operations as the entrance upon the field of an army of new men, in our cities, in small towns, and in rural districts,—with the advent, as I say, of this fresh impulse, there was an immediate and enormous increase in the percentage frequency of ureteral injuries and sequelæ. The flood of inexperience is passing over, however, and I am thankful to note that ureteral injuries are becoming more rare.

The ureteral diseases which call for surgical interference may be divided according to causation into two groups: the surgical and the non-surgical.

The *surgical group* includes all those injuries which arise at the hands of the surgeon in the course of an abdominal or of a pelvic operation. Lesions of this sort are almost exclusively confined to the pelvic portion of the ureter where it lies in close contact with the genital organs which so frequently call for radical operations, in a part of the abdomen where the ureter is less readily traced and exposed to view, and so less readily protected from such accidental injuries.

Inasmuch as pelvic operations are most commonly done upon women, it is evident that the group of ureteral affections referred to must also be found, in an overwhelming majority of instances, in women too.

The surgical lesions of the ureter are: A cut opening the lumen of the ureter, without, however, completely severing it; complete division of the canal; ligation of the ureter; exsection by tearing or by division, in the process of removing an organ, or a segment of the pelvic portion of the ureter; injury to the blood-supply

of the ureter, entailing a subsequent sloughing, kinking, or compression of the ureter by the traction of sutures or the pressure of dressings.

The group of ailments which are not surgical in their origin are: Congenital fistula; fistulæ from injury during labor; strictures; tuberculosis; pyoureter; calculus; malignant disease.

The causes of the various surgical lesions of the ureter, as stated, lie primarily at the door of the surgeon. Such injuries are far more apt to occur in the hands of a neophyte than in the hands of an experienced surgeon. The manifest lesson to be drawn from this fact is a more thorough knowledge of anatomy, and a greater watchfulness in the course of the operation over all its details. Not all lesions, however, are to be charged up to inexperience; in some myomata, in bad inflammatory cases, and in cases of old extrauterine pregnancies, as well as in some badly adherent ovarian tumors, the ureter sticks tight to the affected organ, and as the latter is pulled up from the pelvic floor, in the process of enucleation, the ureter is brought out with it and sacrificed unwittingly.

Perhaps the commonest of all surgical lesions is that due to operations for cancer of the cervix. In the older operations, especially vaginal, when clamps were employed, the injury was often direct. In the more radical operations which we now employ the extensive separation of the ureter from the cancer, frequently required, may lead to an interference with the blood-supply of the ureter; and from this results necrosis and a fistula.

Calculi pass down from the pelvis of the kidney and lodge either just below the starting-point high up in the loin, or stick just above the pelvic brim, or, finally, on the pelvic floor, usually but a short distance from the vesical end of the ureter.

A tuberculosis of a ureter is always secondary to a renal affection. A pyoureter depends upon and is secondary to a stricture, while a stricture is, with a few exceptions, produced by a stone or a tuberculosis.

Primary malignant disease of the ureter is exceedingly rare; secondary involvements take place from the kidney above or from the cervix uteri below (see Fig. 839).

A diagnosis of any of these various ureteral affections is made by noting: (1) The side in which the pain is felt; (2) the point of escape of the urine, in the case of a fistula; (3) the character of the discharge; (4) by making a careful cystoscopic examination of both ureteral orifices associated with a sounding; and (5) a catheterization of each ureter.

It is easy to distinguish a ureteral from a vesical fistula by making an injection of a colored fluid (aniline) into the bladder, which will escape from a vesical and not from a ureteral fistula.

When there is a stone lodged in the ureter, there is usually a well-defined localized pain, and if the stone is low down in the pelvic portion, it can often be felt by vaginal or by rectal palpation.

Both stone and tuberculosis are marked by pain and pus, and often by blood in the urine.

A tubercular ureter feels like a thick nodular cord through the anterior vaginal wall and vault; this is always evidence of disease of long standing in the kidney above, and in the bladder below.

The present status of tuberculosis of the ureter is that it is always descending, and never ascending. The disease follows the excretory current. In the male there are two currents in the genito-urinary apparatus, both making for the bladder—one from the kidney downward, and the other from the epididymis or the seminal vesicles upward.

Injuries to the Ureter.—If a ureteral affection cannot be felt by the finger introduced into the vagina or into the rectum, then there is only one other direct way of discovering the disease without making an incision, and that is by a cystoscopic examination, associated with a catheterization of the diseased ureter. This direct visual procedure is of all methods the most

FIG. 823. — TYPICAL
SCRATCHES ON A
WAXED CATHETER.



satisfactory, because the most positive and convincing. In the first place, if there is an inflammatory disease, such as a tuberculosis on the affected side, the orifice of the ureter of that side appears edematous, or much reddened, or ulcerated. Sometimes it appears as a little pocket, and is displaced toward the posterior lateral part of the bladder. On introducing a catheter into the ureter, a stricture is recognized either as an obstruction or as a narrowing, through which the catheter is forced with difficulty. Once beyond the stricture, the pent-up fluids force their way down the catheter and are discharged until the ureter and the distended pelvis of the kidney are emptied. A considerable accumulation of watery urine, or turbid urine, or pus may be let out in this way. If there is a stone in the ureter, a little coating of wax on the end of the catheter will show the presence of the stone by the gouges or scratch



FIG. 824. — EXAMINING THE SCRATCHED WAXED END OF THE URETERAL CATHETER BY REFLECTED LIGHT.

marks (see Fig. 823) seen on the surface when looked at with a low-power lens after withdrawal (see Fig. 824). Fig. 825 shows a ureteral calculus causing the scratch marks seen in Fig. 823.

If there is a fistula of the ureter, a catheter introduced on the same side as the fistula draws no urine and meets an obstruction, as a rule, a short distance from the ureteral orifice, at the ureteral end of the fistula.

All these direct observations of the affected ureter are associated with similar observations of the opposite side, which may be seen to be discharging its urine normally, at intervals of a few seconds, in clear jets. It is best, as a rule, to avoid catheterizing a sound ureter, if there is much disease in the bladder. Enough urine for careful bacteriologic and microscopic examination can be caught in the speculum without introducing a catheter.



FIG. 825.—URETERAL CALCULUS LODGED ABOVE THE VESICAL ORIFICE GIVING SCRATCH MARKS.

Early Treatment of Diseases of the Ureter.—Treatment of a surgically injured ureter differs according as the injury is recent, that is to say,

just made and discovered in the course of an operation, or inflicted some time before and causing a fistula of weeks or months standing. Sometimes the kidney of the side involved is extensively diseased, owing to the distention of the ureter by the pressure of a pelvic tumor and a subsequent infection. In an instance of this kind, if the patient's condition will permit it, and the opposite kidney is known to be sound, it is best to take out the kidney at once. If the patient is too ill for such a radical operation, then the diseased ureter should be brought to the surface of the body, sewn into the angle of the incision, and after the patient has recovered, if there is any continued discharge from the fistula, the kidney should be taken out. Where the injury to the ureter is an extensive one, so that it cannot be anastomosed either to the bladder or to the lower end of the ureter, if the opposite kidney is sound, the best plan, in a non-infected case, is either to ligate the ureter and drop it, or to take out the kidney. A ligature must be tied tight, and it is best to insert a small provisional drain in case of a leakage. If the ureter has been divided, or a small portion only has been sacrificed, the best plan then is to tie the lower end, and to anastomose the upper end into the lower below the ligature, by means of the instrument shown in Fig. 826, through a slit in the side of the lower end, as shown in Fig. 832. An end-to-end anastomosis of the ureter may be done under the

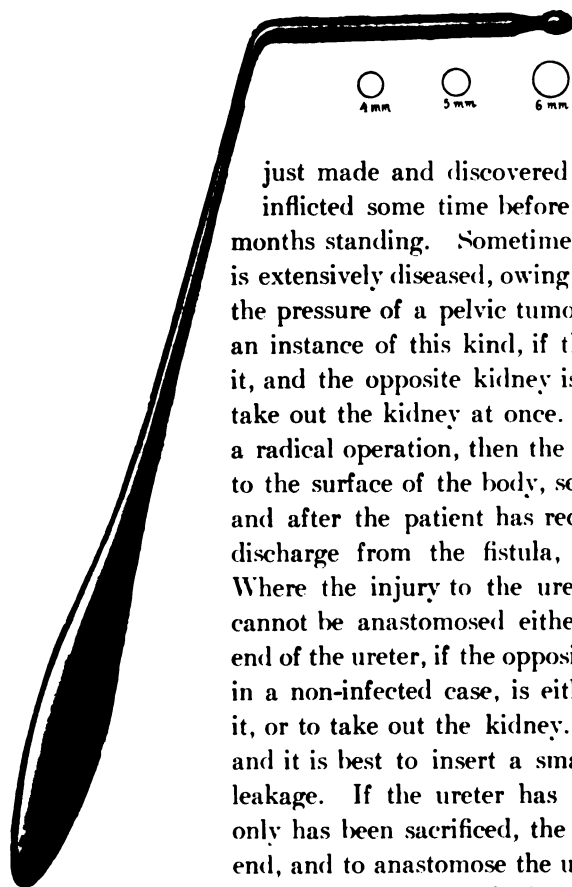


FIG. 826.—ANASTOMO-SIS BOUGIE FOR JOINING ENDS OF URETER.

most favorable circumstances, as when the ureteral walls are thick enough for a thorough suturing without penetrating the mucosa, and when they can be brought snugly together without any tension. If the ureter is injured low down

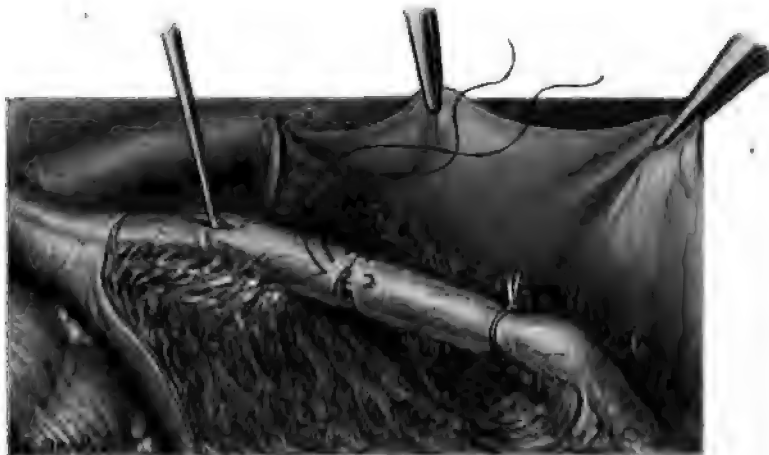


FIG. 827.—ANASTOMOSIS OF URETERAL ENDS AFTER DIVISION ON GUIDE.

After removal of the instrument the little longitudinal incision, through which it was introduced, is also sutured. By rotation of the ureter by traction on the sutures, the posterior part is exposed as well.

in the pelvis, the best plan then is to make a little opening in the posterior wall of the bladder, near the side of the pelvis, and to anastomose the ureter into the bladder retroperitoneally, as shown in Figs. 828, 829, 830, and 831. In all these anastomotic openings it is best to employ fine silk (catgut is also admissible) and to avoid any part of the suture appearing on a mucous surface, where it can be brought into contact with the urine. It is also best in all these operations to avoid, so far as possible, any extensive denudation or detachment or rough handling of the ureter itself. The ureter cannot be lifted completely out of its bed for a stretch of several inches without great risk of its sloughing.

In every instance, also, the ureter should be covered by peritoneum and kept as far away as possible from any areas to be closed by granulation. A little drain down to the point of anastomosis constitutes a temporary safeguard, for which the operator will sometimes be thankful. If there is no escape of urine, the drain can be slipped out in four or five days.



FIG. 828.—A METHOD OF TURNING THE URETER INTO THE BLADDER (G. HUNTER).

Late Operations for Surgical Injury of the Ureter.—In a late operation

for a surgical injury of the ureter one has always to do with a fistula, and the first question of importance coming up for solution is this:

Is the function of the kidney on the fistulous side materially impaired?

How much urea *per diem* is excreted through the fistulous ureter?

Is there any infection of the fistulous side?

Is the opposite kidney capable of doing all the work, and of maintaining life?



FIG. 829.—SHOWING A WORKING INCISION INTO THE VERTEX OF THE BLADDER, USED TO DRAW THE URETER THROUGH THE LITTLE OPENING MADE IN THE BLADDER AT THE NEAREST POINT, SECURING AN EXTRAPERITONEAL IMPLANTATION.

The operator will determine upon his course according to the answers given to these questions. The operation for an old fistula of the ureter, though often successful, is by no means simple. It may in any given case unexpectedly prove one of the most delicate and difficult pieces of surgery the surgeon can be called upon to perform. The ureter may be cut off at some distance from the bladder and the fistulous orifice may itself lie at some little distance from the ureter

proper. The operator, on cutting down to the ureter, may find it so buried in scar tissue as to necessitate the sacrifice of a considerable portion of the ureter in order to reach the healthy part capable of anastomosis, and having reached this part, he may then find it impossible to carry it across the distance lying between the ureter and the bladder. He must, for this reason, be well posted as to the safety of removing the fistulous kidney in the case of necessity.

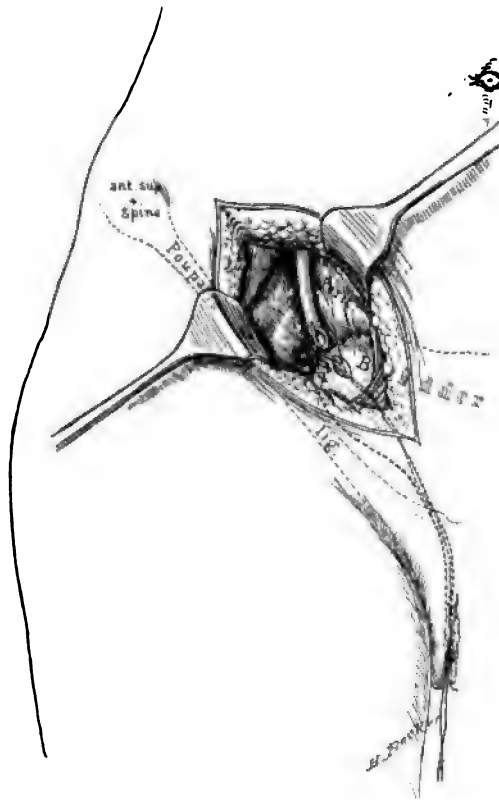


FIG. 830.—RETROPERITONEAL ANASTOMOSIS OF SHORTENED URETER INTO BLADDER.

Figure shows traction suture introduced through urethra, in order to pull ureter through little opening near dorsum of bladder. Note obliquity of ureteral orifice.

What to do for Ureteral Fistulæ.—In investigating the discharge from a ureteral fistula, it is not safe to run a ureteral catheter up into the ureter, as this may cause a serious ascending infection. The better plan is to put the patient on a bed-pan and collect the discharge as it runs out for several hours, and then to examine this for urea. If the urea is very low, and, above all, if there is an infection, it would be wiser to take out the kidney than to attempt an anastomosis, which is most likely to fail under such conditions. Where the fistula opens at the vault of the vagina, it is sometimes a sore temptation to the plastic surgeon to turn the ureter into the bladder by one of the various methods devised. This operation, however, is more attractive on paper than in the actual performance, as it is difficult and liable to fail. The writer succeeded in one case, where there was a ureteral fistula at the vaginal vault involving both ureters, in cutting open the bladder at a point close to the ureters and sewing the lower lip of the cut bladder to a denuded strip extend-

ing across the vagina behind the ureters, in this way turning a little area of the vaginal vault with the ureteral fistulæ into the bladder. This operation was perfectly successful, but it is difficult and not likely to succeed as a routine procedure. The anastomosis of an old fistula ought to be made, as a rule, above the symphysis through a lateral incision, through the linea semilunaris, extraperitoneally. Such an incision should be made low down and the peritoneum turned back from the iliac vessels and the pelvic wall until the ureter is found. The ureter should then be detached with great care from its surroundings and cut loose from

the fistulous opening in a healthy part of the organ, after which the bladder is drawn to the ureter and the anastomosis effected through a little slit in the lateral vesical wall. Years ago I devised the plan of loosening the bladder from its surroundings, and pulling it back in the pelvis, to meet a short ureter, in this way effecting an anastomosis without tension, which otherwise would have been impossible. If the peritoneum is torn in freeing the ureter, it will be best to put in a drain for a time; and a drainage opening at the vaginal vault is preferable to one upon the abdomen.

Congenital Fistula.—In a congenital fistula the ureter opens into the urethra, or into the vestibule, or at a point below its normal orifice of discharge into the bladder. In such cases, if the ureter is distended above, an incision into the enlarged ureter may be made through the bladder wall, preferably with a thermocautery, in this way short-circuiting the fistula.

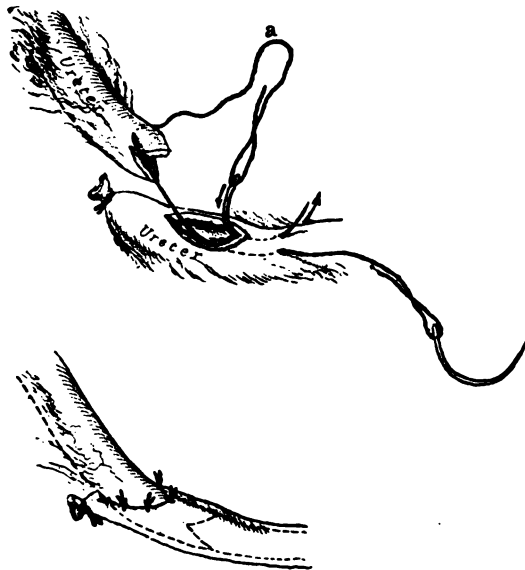


FIG. 832.—WELLER VAN HOOK'S METHOD OF END-TO-SIDE ANASTOMOSIS OF THE UPPER END OF THE URETER INTO THE LOWER.

In the upper figure the distal portion is tied and slit, while the upper end is being drawn into the slit by the temporary suture, a. The lower part of the figure shows the anastomosis completed by the suture of the entering portion to the margins of the slit, the traction suture being withdrawn.

bladder, an incision for the removal of a stone may be made at a point from the loin posteriorly to the vagina below.

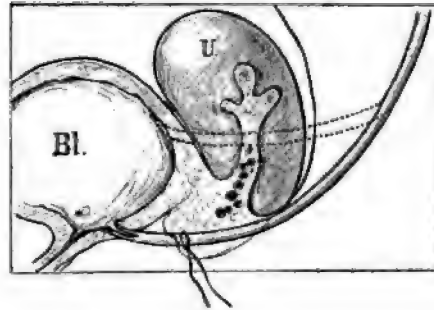


FIG. 831.—LATERAL VIEW OF A TRANSPLANTED URETER (G. Hünner).

The new ureter occupies the position of the dotted line, and passes above the uterine vessels.

Calculus of the Ureter.—In calculus of the ureter, after determining the presence of a stone, and the condition of the kidney on that side, the operator is chiefly concerned to know just where the calculus is situated. This will be determined by noting the point of obstruction with the ureteral catheter, as impeding the progress of the catheter, as well as by noting the exact point at which the catheter on withdrawal is felt to be liberated from the grasp of the calculus, pinching it against the ureteral wall. An x-ray picture also gives precise information as to the location of the stone.

Inasmuch as the course of the ureter is a long one from the pelvis of the kidney to the neck of the



FIG. 833.—PRELIMINARY FINE SILK SUTURES PASSED THROUGH THE OUTER WALLS OF THE URETER BEFORE INCISING AND REMOVING THE STONE.

In making the incision to remove the stone, the sutures must be pulled widely apart.

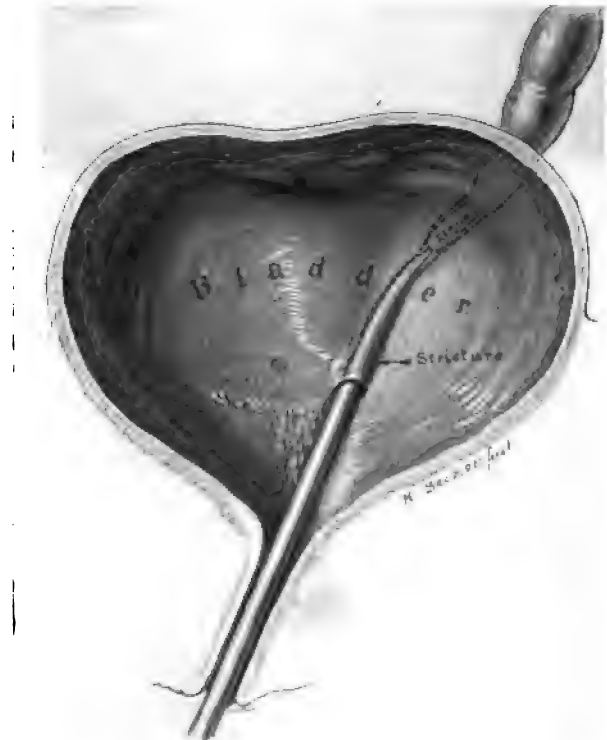


FIG. 834.—A STRICTURED URETERAL ORIFICE WITH A STONE LODGED ABOVE IT.

The metal dilator, 2.5 mm. in diameter, is seen introduced as far as the stone. This was followed by dilators to the size of 5 mm.

If the stone is up near the kidney, a posterior incision is made as in suspension of the kidney, when the kidney is rotated by pulling on its fatty capsule with a number of forceps until the ureter is brought into the field of operation. A delicate longitudinal incision is made over the stone, avoiding the vessels, when the stone is carefully lifted out, taking care not to tear the wall of the ureter, after which the incision is closed with delicate silk sutures, slightly infolding the ureteral wall (see Fig. 833). If the stone is lodged above the brim of the pelvis, the incision made may be like that for the removal of the appendix, avoiding, however, the opening of the peritoneum. Upon reflecting the peritoneum with the colon and cecum, the ureter is exposed, adhering to the peritoneum, and the stone is readily located by touch, and then exposed and excised by a longitudinal incision long enough

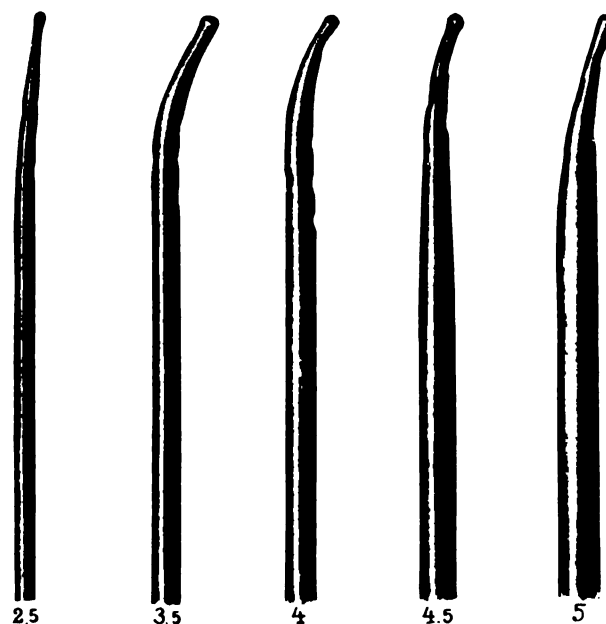


FIG. 835.—URETERAL DILATORS FROM SIZE 2.5 TO 5 MM.

to take it out easily, without tearing the ureter. When the ureter is dilated, as it often is above a stone which has long been embedded on the pelvic floor, it is sometimes easier to get at the stone by pushing up the dilated ureter to a more convenient and accessible point above the brim (Israel), when it is removed and the wound sutured as usual.

A stone in the extreme lower part of the ureter, just behind the bladder or juxtavesical, which cannot readily be thrust upward, may be removed by a lateral incision in the linea semilunaris, separating the peritoneum from the pelvic wall, until the ureter and the stone are felt. These cases are sometimes difficult, owing to the depth of the pelvis and the inaccessibility of the stone. I have had a case in which a stone lodged in the lower end of the ureter (see Fig. 834) was induced

to escape without a cutting operation by dilating the narrow ureteral orifice with hollow bougies (see Fig. 835) up to the size of 5 mm. in diameter. In women the most satisfactory avenue for the removal of a ureteral stone, when it can be reached by the vagina, is through an incision in the vaginal wall directly over the stone. The ureter is thus exposed and incised longitudinally, the stone removed, and if the case is an aseptic one, the wound may be closed. It is best in such cases, if there is any doubt about the suturing of the ureter, to leave in a drain, not attempting to close the vagina entirely. Even if a fistula is formed, it is sure to get well of itself in a few weeks' time. When the stone can be seen by the cystoscope, projecting into the bladder (see Fig. 836), or when the stone is so far down as to cause

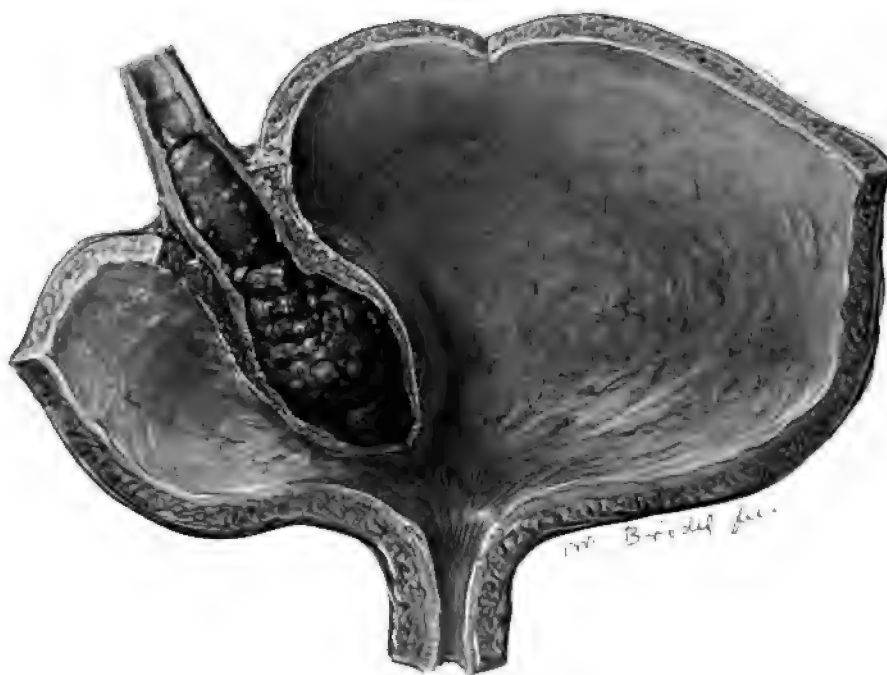


FIG. 836.—CALCULI LODGED IN THE VESICAL END OF THE URETER AND PROJECTING INTO THE BLADDER.

a bulging of the vesical mucosa into the lumen of the bladder (see Fig. 837), a good way, in women, is to open the air-distended bladder in the knee-breast posture, to retract the margins of the incision, exposing the hard bulging tumor, and then, by means of a simple incision with alligator scissors, to lay bare and remove the stone. If there is any doubt as to whether all stones have been removed, it will be a wise plan not to close the vaginal incision, but to leave it to close spontaneously.

A valuable method for locating the position of the stone is to catheterize both ureters, as shown in the diagram (see Fig. 838). The right catheter has entered the full length of the ureter and the renal pelvis, while the left catheter stops short at a supposed stricture or stone. The catheters are then grasped as one at the vul-

var orifice and drawn out together. The difference in distance between the tips of the catheters measures the difference between the top of the pelvis of the kidney and the site of the obstruction.

A stricture of the ureter is usually associated with some other disease, such as tuberculosis or calculus, when it does not call for treatment *per se*. However, a stricture is sometimes found at the vesical orifice, due to a localized catarrhal condition within the bladder. Such an interesting affection is associated with a



FIG. 837.—LIBERATION OF A CALCULUS BULGING OUT INTO THE BLADDER BY INCISING THE VESICOUTERINE SEPTUM IN THE KNEE-BREAST POSITION, AND THEN INCISING THE THINNED-OUT VESICAL MUCOSA AND THE URETERAL WALL.

distention of the ureter and a curious pouting or bulging of the ureter into the lumen of the bladder. When such a condition is recognized cystoscopically, the only treatment necessary is to slit the bag in a moment of extreme distention, thus effecting a wide opening into the bladder, which nature will maintain.

Tuberculosis of the Ureter.—A ureter which is greatly thickened with tuberculosis ought always to be removed, either at the time of removal of the diseased kidney or as a secondary step after the patient has recovered. Patients who carry large, thick, tubercular ureters rarely, if ever, make a good, complete recovery,

but suffer more or less from dysuria and the constant infection of the bladder. While this is true, it is also true on the other hand that a ureter which appears a little thickened or somewhat cord-like, and which an operator without great experience is apt to mistake for a tubercular ureter, is best let alone. The cord-like condition of the ureter is not often due to a tubercular infiltration. Ureterectomy

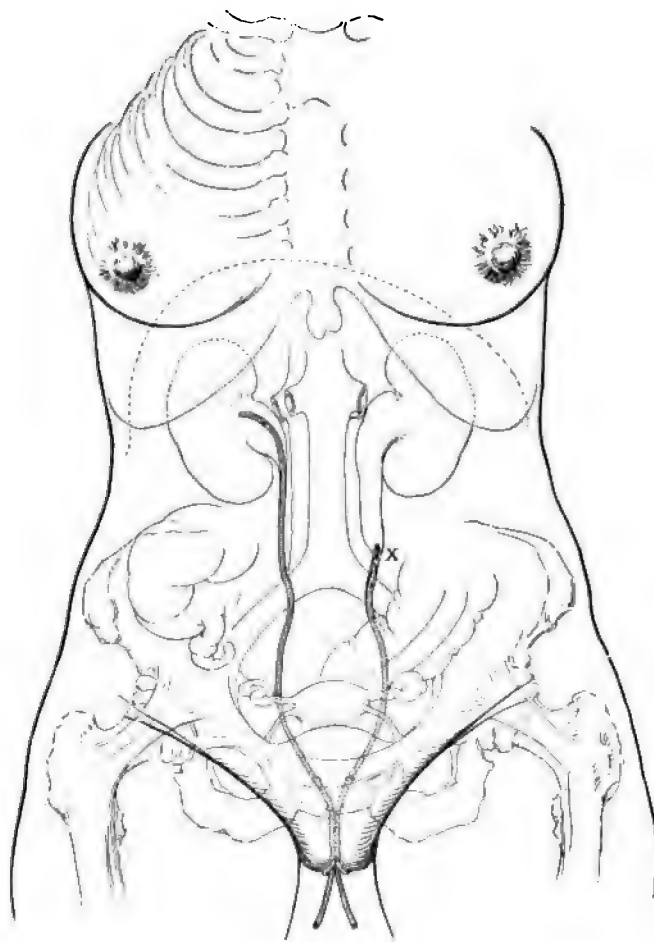


FIG. 838. —SHOWS THE METHOD OF ESTIMATING THE EXACT POSITION OF A URETERAL OBSTRUCTION.

The catheter on the right side enters its full length, say 28 cm., while that on the left stops short at the obstruction X, say 18 cm. short of the top of the renal pelvis. Upon grasping both catheters between thumb and forefinger at the vulva, and withdrawing them simultaneously, so as to preserve their relative positions in the body, the difference in the level between the top of the renal pelvis and the obstruction is easily estimated.

is less frequently done now than ten years ago. The ideal operation for removal of the ureter is a nephro-ureterectomy, in which kidney and ureter are removed in one piece, without contamination of the contiguous tissues. It is best, as a rule, to release the kidney first by a suitable posterior or lateral incision, and then to free the ureter as far as possible, usually as far as the pelvic brim; the operator

next makes an incision in the semilunar line over the true pelvis and lays bare the ureter at the brim of the pelvis, and then pushing the kidney with the attached ureter under the broad bridge of abdominal wall, left intact between the incision in the loin and the incision in front in the lower abdomen, concludes the operation by extirpating the pelvic portion of the ureter. If this operation is done gently and carefully, there ought to be no trouble of any moment after the detachment of the kidney. The ureter should be ligated at its vesical origin, and the end sterilized and dropped. Great care must be taken throughout not to contaminate the wound with any infected material from the kidney or ureter. It is sometimes best to tie off the uterine vessels in order to expose the lower end of the ureter. In other cases the anterior portion of the ureter can be reached by enlarging the little hole, through which it passes under the broad ligament, with the finger, and then pulling the ureter back until the vesical end is exposed. This cannot be done so well if the lower end is much diseased. I have in several instances excised portions of the bladder with the kidney and the ureter, doing a nephro-ureterocystectomy. In such a case the bladder must be sewed up with great care with at least one layer of fine silk sutures, and a drain should be dropped down to the bladder wound, to act as a safety-valve for five or six days.

Malignant disease of the ureter very rarely calls for treatment as an affection by itself. It is nearly always secondary to malignant disease of an adjacent organ, and as the ureter is only involved in the later stages of the affection, an operation is out of the question.



FIG. 839.—A CASE OF CARCINOMA OF THE CERVIX, OBSTRUCTING THE URETERS.

Showing the involvement of the pelvis of the ureter in the one form of malignant disease which is common to it, and one mode of producing death. On the left side the ureter is double throughout.

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CHAPTER XLIV.

SURGERY OF THE KIDNEY

BY CHARLES P. NOBLE, M.D., AND BROOKE M. ANSPACH, M.D.

HISTORY.

The first operations ever performed on the kidney most likely were incisions into the paranephric area or nephrotomies undertaken to evacuate a collection of pus. In 1757 Hévin¹ wrote: "It is very doubtful, if not absolutely improbable, that cutting into the kidney had ever been practised without operation having been determined by an abscess swelling, or by a fistula due to renal abscess, which had broken and discharged in the lumbar region."

According to Henry Morris,² the practicability of nephrectomy was repeatedly discussed in the sixteenth, seventeenth, and eighteenth centuries by Camerarius, Rousset, Shenck, Duclédat, Cousinot, Riolan, von Hilden, Lafitte, Borden, Hévin, and Lédran. Gerdy, in 1829, referred to the subject at considerable length. Physiologic experiments had shown as early as 1670 that life could be maintained after removing one of the kidneys; nevertheless there was great prejudice against the operation.

Pilcher³ says that in 1840 Rayer, in his "Maladies des Reins," t. iii, p. 240, "summed up the wisdom of the ages as to the removal of a kidney in his sentence: 'It would be folly to attempt such an operation.' The accounts of the cases of the free archer of Bagnolet and of Hobson the English consul at Venice, in the case of each of whom it is related that under peculiar circumstances a kidney had been cut down upon, stones extracted, and recovery followed, remained as *curiosa chirurgica*." The possibilities in the line of further operative work on the kidneys were suggested by the experience of surgeons in their dealings with ovarian tumors. A number of nephrectomies had been done by mistake. Diseased kidneys had been mistaken for tumors of another nature and removed by operation. In 1868 Peaslee, after having removed a supposedly solid ovarian tumor, found that it was an enlarged kidney. "Although peritonitis carried off the patient on the third day, it was noticed that an adequate urinary discharge was furnished by the remaining kidney up to the time of death."

The first intentional nephrectomy was done by Gustav Simon, of Heidelberg,

¹ Hévin: "Researches, Historical and Critical, on Nephrotomy or Cutting into the Kidney," Mem. de l'Acad. Roy. de Chirurgie, T. iii, part 2, Sec. 24.

² Morris, Henry: "On the Origin and Progress of Renal Surgery," Phila., 1898.

³ Pilcher, L. S.: "The Development of the Surgery of the Kidney with Some of the Lessons Connected Therewith," Ann. Surg., 1900, xxxi, p. 100.

on August 2, 1869. This operation was deliberately undertaken after the case had been carefully studied and after nephrectomy had been practised on animals. It made a great impression. The next nephrectomy, according to Morris, was done by Gilmore in America, December, 1870, on a woman five months pregnant. Pilcher says that von Bruns, in March, 1871, was the first of Simon's imitators. Simon's second operation was performed in August, 1871, for calculous pyelitis; the patient died of pyemia. Brandt in 1873, Marvaud in 1875, Langenbuch in 1875, and Jessop in 1877, performed successful nephrectomies.

Nephrotomy had been suggested three months before Simon's first nephrectomy by Sir Thomas Smith, and in July of the same year Anandale and Spencer Wells advised nephrotomy for renal calculus. Bryant performed the operation in 1870. In the same year Gunn and Durham made incisions into the paranephric area and Lente and Barbour did actual nephrotomies.

In 1878 Martin adopted nephrectomy for painful floating kidney, and had four successful cases. The operation of nephrorrhaphy was substituted for Martin's radical measure by Hahn in 1881. Le Dentu, in 1889, gave the procedure its present name of nephropexy. The first nephropexy in America was done by Weir in 1882.

Paoli,¹ of Perugia, performed resection of the kidney in a number of dogs, cats, and rabbits; the procedure was followed by perfect recovery. An account of this work was published in 1890. Morris reports that the first partial excision of the kidney in the human was by Czerny in 1887; it was done for angiosarcoma following injury.

According to Fenger,² the most notable step in conservative kidney surgery was made by Henry Morris, of London, who on February 11, 1880, had the courage to remove an oxalate of lime stone weighing thirty-one grains from an undistended healthy looking kidney, by an incision through the renal parenchyma. Morris's operation proved that it was possible to save the kidney from the destructive influences of a stone without sacrificing the organ.

ANATOMY OF THE KIDNEY.

Embryology.—The first indication of the kidney is found in the renal duct, which arises in the fourth week of fetal life as a small epithelial proliferation from the Wolffian duct, a short distance above its entrance into the cloaca.³

Position.—The kidneys lie deep in the loins, along the last dorsal and the first three lumbar vertebræ. The right kidney is from one-third to three-fourths of an inch lower than the left, presumably because of the position of the liver immediately above. The right kidney extends as high as the lower border of the eleventh rib; the left kidney as high as the upper border of the same rib. Their

¹ Paoli: "Étude expérimentale sur la resection du rein," Verh. des X Internat. Med. Cong., Berlin, 1890, Bd. iii, Abth. vii, S. 248.

² Fenger, Christian: "Diseases of the Kidney Amenable to Operative Treatment," Clinical Review, Nov., 1899, xi, 77-102.

³ Küster, E.: "Die Chirurgie der Nieren," Lief. 52b, Deutsche Chirurgie, Stuttgart, 1896.

superior and their inferior limits are on a level with the upper borders of the tips of the spines of the twelfth dorsal and the third lumbar vertebræ respectively. The long axes of the organs are oblique, in consequence of which the upper ends are 8.5 cm., while the lower are 11 cm., distant from the spinal column.¹

Each kidney also is rotated slightly backward on its long axis, so that the plane of the inner margin is anterior to the plane of the outer margin. The posterior surfaces of the kidneys look backward and inward toward the spinal column. The upper one-third of the posterior surface is in relation with the diaphragm, and the lower two-thirds is in relation with the fascia overlying the psoas magnus muscle and with the anterior lamella of the lumbar fascia covering the quadratus lumborum muscle. The anterior branch of the hypogastric, the ilio-hypogastric, and the ilio-inguinal nerves pass outward behind the lower half of the kidney.

Kidney Capsule.—The kidneys are retroperitoneal and are invested by connective tissue which is extraperitoneal in origin.

The fatty capsule is developed especially on the posterior aspect of the kidney about the convex border and the lower pole; in front it is very thin. Beneath the inferior extremity of the kidney it forms quite a pad or bolster for the organ, and is continuous with the cellulo-fatty tissue of the false pelvis. The fatty capsule itself is confined between the two layers of what is known as the perinephric fascia, and throughout its extent there are fibrous septa which pass from the kidney to these layers. The anterior and the posterior layers of the perinephric fascia unite above and to the outer side, but not below and to the inner side.

The anterior layer, which is the thinner, is closely applied to the posterior surface of the peritoneum; passing over the anterior surface of the kidney and the structures at the hilum, it unites in the median line with its fellow of the opposite side. Above the suprarenal gland the anterior layer fuses with the posterior layer and is firmly united to the diaphragm. Below the kidney it becomes attenuated and merges with the cellular layer of the pelvic fascia.

The posterior layer is attached along the median line to the bodies of the vertebræ and the intervertebral discs; it passes over the psoas muscle and over the posterior layer of the lumbar fascia covering the quadratus lumborum; after joining the anterior layer above the suprarenal gland and along the upper convex border of the kidney, it merges with the subperitoneal fascia.

This arrangement of the perinephric fascia and the fatty capsule, which is for the purpose of supporting the kidney, permitting at the same time a small range of mobility, explains the tendency of the organ to prolapse downward and inward. Normally the peritoneum moves slightly with the kidney, but the kidney also moves slightly with its perinephric fascia under the peritoneum. The fatty capsule in turn is mobile within the perinephric fascia and the kidney within the fatty capsule. The capsule proper of the kidney is a thin though well-defined fibrous coat; it enters the hilum and lines a part of the sinus.²

¹ Piersol, Geo. A.: "Human Anatomy," Phila., 1907.

² Morris, Henry: "Surgical Diseases of the Kidney and Ureter," London, 1901.

Relations of the Kidney.—Each kidney weighs from four to five ounces (110 to 140 grams). The upper part of the right kidney is in relation with the liver and is covered with peritoneum. The ascending colon crosses the kidney below its middle, and at this point there is therefore no peritoneal covering. The lower extremity of the right kidney is in contact with the jejunum and is covered with peritoneum; the mesial margin of the kidney is overlapped by the descending duodenum and is non-peritoneal.

The upper anterior surface of the left kidney is in contact with the stomach and is covered with peritoneum. The upper external margin is in contact with the spleen and has a peritoneal covering. The tail of the pancreas crosses the middle part, which is non-peritoneal. Below and to the outer side, the kidney is in relation with the mesocolon; to the inner side it is in contact with the jejunum and is covered with peritoneum.

Hilum of the Kidney.—The extremities of the kidney are rounded, the upper extremity being thicker and broader than the lower, and surmounted by the supra-renal capsule. The external margin is convex in outline and is unattached. The internal margin is concave and is connected with the ureter, blood-vessels, lymphatics, and nerves of the kidney. These structures enter the kidney through a longitudinal fissure or slit known as the hilum, which opens into a C-shaped chamber called the sinus of the kidney. The latter is largely occupied by the expanded upper extremity of the ureter, which, with its subdivisions the calyces, is spoken of as the renal pelvis.

The structures which pass through the hilum and enter the sinus of the kidney are, from before backward, branches of the renal vein, branches of the renal artery, other branches of the renal vein, and the ureter. The renal artery is derived from the abdominal aorta, and is very large in proportion to the size of the organ which it supplies.¹ The renal vein empties into the inferior vena cava. The renal nerves are derived from the solar plexus and the lesser splanchnic nerves. Their branches accompany the blood-vessels. The renal lymphatics are: superficial, covering the surface; and deep, accompanying the blood-vessels. They empty into the lumbar glands.

The Relation of the Vascular Supply of the Kidney to the Kidney Pelvis and Calyces.—The configuration of the renal pelvis and calyces, and the distribution of the renal artery in the kidney substance, is of considerable importance from a surgical standpoint. The pelvis of the kidney may consist of one common sac or it may be divided into two, each of which communicates with the calyces in its respective situation, and opens separately into the upper end of the ureter.

Brödel,² who examined a series of seventy kidneys, finds that in the ideal form there are eight calyces, all of which communicate with the common kidney pelvis, the expanded upper extremity of the ureter. The longitudinal plane of the pelvis

¹ Deaver, John B.: "Surgical Anatomy," Phila., 1903.

² Brödel, Max: "The Intrinsic Blood Vessels of the Kidney and their Significance in Nephrotomy," Johns Hopkins Hosp. Bull., 1901, vol. xii, No. 118, p. 10.

runs obliquely from the posterior inner margin of the kidney to the outer one-third of its anterior surface.

There are eight calyces, an upper and a lower one, and six between them, arranged in two rows, one anterior, the other posterior. Each row leaves the longitudinal plane of the kidney pelvis at about the same angle, the anterior calyces being directed toward the convex anterior region of the kidney and the posterior to a line just a little behind the lateral convex border.

In the case of a divided pelvis there is a zone of cortical substance which extends to the hilum and divides the upper pelvis from the lower. The lower pelvis receives, as a rule, the greater number of calyces. There are usually more than eight calyces in a kidney with a divided pelvis. Such a kidney often preserves its fetal lobulations and has an abnormal arterial circulation. The division between the individual sections of the pelvis is generally marked on the surface by an especially deep groove, and it may appear as though there were two separate kidneys, one on top of the other.

Frequently, according to Brödel, they are really separate organs so far as their arterial distribution and their excretory functions are concerned. Separate renal arteries are commonly associated with fetal lobulation of the kidneys. Organs having a lobulated form usually exhibit a long hilum, with separate arteries and an abnormal renal pelvis. The veins, as a rule, however, collect in one single trunk.¹

The renal artery divides at the hilum of the kidney into four or five branches. Most of them (three-fourths, as a rule) run anteriorly to the pelvis. The branches of the anterior never cross over to the posterior division or *vice versa*. They do not anastomose with each other, being end-arteries in the strictest sense of the word. The plane of division between the two arterial trees corresponds to the plane of the axes of the posterior row of calyces. It may be spoken of as the bloodless area of the kidney and is the plane of election for nephrotomy incisions.

The most vascular plane of the kidney, and the line of incision to be avoided in nephrotomy, passes through the columns of Bertini. The latter consist of cortical kidney tissue which dips down between the anterior and the posterior row of pyramids.

The position of these planes may be determined by the surface markings of the kidney.

The anterior surface of the normal kidney is convex; the posterior surface is somewhat flattened. Near the outer convex border and on the anterior surface there is a longitudinal furrow, which indicates the position of the columns of Bertini.

The plane of the avascular area is posterior to the columns of Bertini. It passes from a longitudinal line slightly behind the extreme outer convex border of the kidney through the center of the hilum and nearly parallel to the posterior surface (Fig. 840). An additional advantage of such a section of the kidney is found in

¹ The reader is referred to Brödel's paper for a detailed description of the kidney veins.

or in the malformation caused by a fusion of the kidneys; or the otherwise normal kidneys may be permanently displaced. Alterations in position occur most frequently, however, in fused kidneys. They are usually in the median line, in front of the great vessels; much more rarely, and only in certain forms, do they both lie to the same side of the vertebral column. Even when in the median line they are at a lower level than normal, and in extreme cases they may lie in the hollow of the sacrum. Then the ureters are short and the renal arteries take their origin from the common or the external iliac. A displacement of this type may be the source of dystocia in labor.

Much more rarely a single well-formed kidney may be permanently displaced. A case is reported in which the right kidney lay in the hollow of the sacrum to the left of the median line. The kidney has also been found in congenital hernia.

TRAUMATIC INJURY OF THE KIDNEY.

Kidney injuries may be connected with open wounds or they may be subparietal.

Etiology.—Penetrating wounds of the kidney are commonly produced either by a knife or a bullet. Subparietal injury of the kidney may be the result of either direct or indirect violence. Thus a thrust or a blow in the lumbar region or beneath the costal margin anteriorly, compression of this part of the body between two apposed surfaces, as car-buffers, or a crushing pressure, as that of a cart-wheel passing over the lumbar region, may directly injure the kidney. Indirect violence, such as the jar of a heavy fall, a sudden contraction of the muscles in the neighborhood of the kidney, and extreme flexion of the trunk, may indirectly injure the kidney.

A kidney injury is often complicated by a fractured rib or a wound of an adjacent viscus.

As Keen¹ has pointed out, a traumatic lesion of the kidney is usually unilateral; the opposite kidney is healthy, and any surgical work necessitated by the accident may be carried out under the presumption that the opposite kidney is healthy and can supplement the work of the injured one.

Pathology.—*Penetrating, Gunshot, and Stab Wounds.*—Penetrating wounds of the kidney are frequently complicated by injuries to the adjacent organs. The wound is apt to contain shreds of clothing or other foreign bodies. The injury may involve alone, or in combination the kidney tissue itself, the kidney pelvis, the renal blood-vessels, and the ureter. Wounds which involve only the cortical renal tissue do not give rise to extravasation of urine or to much hemorrhage. When, however, the pelvis or the calyces are wounded, extravasation of urine occurs and bleeding is more marked. If the renal vessels are torn, the hemorrhage may be fatal. If there is no injury to the peritoneum, the blood will either escape through the ureter or pass into the retroperitoneal connective tissue. If the peritoneum is wounded, the hemorrhage may be intraperitoneal.

¹ Keen, W. W.: "Treatment of Traumatic Lesions of the Kidney, with Tables of 155 Cases," *Ann. Surg.*, 1896, xxiv, p. 138.

It is very rare for the ureter alone to be wounded. Other organs are less apt to be injured in stab wounds than in gunshot injuries. When an individual is stabbed in the kidney region from the front, the kidney usually escapes injury. A stab wound in the lumbar region may be complicated by a protrusion of the kidney through the wound.

Subparietal Injury; Rupture of the Kidney.—A subparietal injury of the kidney, according to Keen, may vary in degree as well as in extent. It may consist of a more or less extensive bruise of the renal tissue with no destruction of the capsule or solution of continuity reaching the surface. It may be an actual tear of the capsule as well as of the renal substance, or it may involve the renal substance alone. It may involve not only the renal substance, but also the renal pelvis, so that the organ may even be torn into separate pieces.

While the smaller vessels necessarily must be involved in every bruise or tear, not infrequently the larger ones are seriously damaged, and rarely the kidney is entirely detached from them.

The ureter may be torn not only into the pelvis, but entirely across, so that it is separated from the organ; and the kidney not only may be ruptured, but even pulvified. Along with a rupture of one kidney, even of a minor degree, the paranephric tissue itself may be more or less lacerated.

The amount of hemorrhage and of urinary extravasation in rupture of the kidney depends upon the location and the extent of the injury. The more the calyces and the kidney pelvis are involved, the more free hemorrhage and urinary extravasation there will be. Even in severe bruises of the kidney substance the hemorrhage is limited if the capsule remains intact, or if there are firm adhesions between the kidney and its fatty capsule. Blood or urine gaining entrance to the paranephric area may become encapsulated or it may invade the retroperitoneal connective tissue involving the mesocolon, the mesentery, the inguinal canal, or the anterior abdominal wall about the external ring.

Hemorrhage into the paranephric tissue may be so extensive as to endanger life. If the peritoneum is torn, hemorrhage is more apt to be serious, and sometimes it is fatal. There is grave danger of peritonitis if the urine is not entirely bland. Rupture of the peritoneum is more common in adults than in children, because there is less development of the fatty capsule in front and the peritoneum lies more directly in relation with the kidney.

There is usually hematuria in cases of ruptured kidney. As a rule, the blood is mixed with the urine, but occasionally clots are formed. The hemorrhage may not be apparent externally for several reasons: The ureter may become plugged with clots; there may be thrombosis of the renal vessels; the ureter may be completely ruptured or it may be the seat of a stenosis.

The danger associated with a case of ruptured kidney arises primarily from hemorrhage, and secondarily from infection. Infection may involve encapsulated collections of blood, the injured and devitalized kidney substance, or the cellular tissue infiltrated with urine.

Symptoms.—The symptoms of a traumatic lesion of the kidney depend upon the nature of the wound and the exact part of the kidney which is injured.

In *gunshot and stab wounds* of the kidney the position of the wound of entrance and the direction of its tract may indicate kidney involvement. If combined with this there is hematuria or a discharge of urine from the wound, the diagnosis is almost certain. When the course of the wound is not clear, hematuria and the symptoms common to kidney injuries will suggest the diagnosis. Urinary extravasation and the amount of hemorrhage depend on the part of the kidney involved. In some *stab wounds* of the kidney the diagnosis may be facilitated by palpating the kidney through the wound. Quite frequently when the wound is of some size and has been inflicted in the loin below the ribs, the kidney prolapses into the wound.

The general symptoms of *a kidney injury from whatever cause* vary to a considerable extent. In a serious case they are usually those of great shock and severe collapse. Prostration is marked. The face is pale and covered with cold sweat. Vomiting frequently occurs. The patient finds a position which lessens the pain, and anxiously guards against any change from it. The first symptom may be no more than a brief faint, without any general indications of a serious injury, although grave symptoms of internal hemorrhage may develop subsequently after the patient has walked or ridden for some distance.

The pain in these cases is described as a heavy, nagging, boring, or shooting pain in the depths of the lumbar region, radiating in various directions, but especially along the course of the ureter. Any movement or any local pressure increases it. The kidney pain must be distinguished from that due to superficial bruises or lacerations, or from associated injury to the ribs. When the kidney lesion is less serious, the pain is not severe, but consists of a dull uneasiness or pressure, which does not incapacitate the patient for work. The pain may be of a sickening character. Agonizing renal colic occurs at times and is indicative of the passage of blood-clots through the ureter. The respiratory motions are limited, the belly muscles being contracted and the surface of the belly hard.

The local symptoms include ecchymoses and tumor formation. Superficial ecchymoses in the lumbar region are of little significance, aside from indicating the site to which the rupturing force was applied; they are caused by the direct injury of the superficial tissues. A tumor of the kidney may form very quickly and be easily distinguished by palpation, or in extreme cases by inspection. A tumor may develop very slowly, or in less serious cases may not occur at all.

Late evidences of deep hemorrhage are found in bruise-like discolorations of the skin appearing about the external inguinal ring; they are due to an infiltration of blood along the retroperitoneal cellular tissue accompanying the spermatic cord.

Hematuria occurs in considerable amount only in those cases in which the injury has involved the calyces and the kidney pelvis. If the blood remains fluid as it passes through the ureter, the bladder fills up quickly, and upon attempting to urinate the patient is alarmed at passing apparently pure blood; or it may be impossible for the patient to pass urine on account of insufficient contraction of

the belly muscles due to reflex inhibition or to injury, or because the blood in the bladder has clotted. In a large majority of cases hematuria is less marked; it may be only microscopic. Very often several hours elapse after the injury before the patient has a desire to urinate, and then the act is accomplished with pain and the urine is bloody. Hematuria may not appear even in severe injuries if the conditions described on page 755 obtain.

Hematuria in itself is not pathognomonic of an actual rupture of the kidney. It may be the result of a simple contusion or the disturbance of a quiescent lesion existing before the accident. In eighteen cases of hematuria noted by Morris the symptom persisted for three weeks in two cases, and from three to eight days in the others. Hematuria may be remittent. After one or two evacuations the urine may be nearly or entirely clear. This would indicate, as a rule, slight involvement of the kidney calyces and pelvis. In all severe cases hematuria is marked. Very rarely it leads to death within twenty-four hours. In fatal cases the loss of blood persists for some time, perhaps remittently, the patient becomes exhausted gradually, and at length a more marked hemorrhage ends in dissolution.

There is usually a diminution of the urinary excretion which may be insignificant or marked, depending, as a rule, upon the extent of the lesion. Rarely polyuria may ensue. Anuria may be an evidence that the bladder, or that both kidney pelves, are ruptured; or it may result from the obliteration of the renal arteries; or it may indicate the existence of but one kidney, and that the injured one. There is a form of anuria which apparently is reflex. The uninjured kidney suffers a contraction of its vessels due to an irritation of the vagus and the splanchnic nerves; the excretion of urine is suspended and may never be resumed. If the bladder is full of urine at the time of the accident, the symptoms of anuria will not appear immediately. The reaction of the urine remains acid if the kidney has been previously healthy. After the blood disappears from the urine, there may be albuminuria, caused, according to Billroth, by traumatic nephritis. Traumatic albuminuria may occur in cases of kidney injury without any previous hematuria.

Prognosis.—According to Küster, nearly one-half of all kidney injuries cause death. About one-half of all uncomplicated kidney injuries end in recovery.

Treatment.—The first efforts of the physician should be in the direction of combating shock and relieving pain. Rest in bed, allowing the patient to take the position which he finds most comfortable; cardiac stimulants to overcome the great weakness; and hypodermic injections of morphin, should be prescribed. The use of ergot, gallic acid, etc., is of doubtful value, but may be tried, and an ice-bag should be placed over the kidney region.

After reaction has occurred, the subsequent course of procedure must be determined, and this will depend upon the cause and the extent of the injury.

When the general symptoms are not marked, the patient reacts quickly, the wound is small and clean, and the hemorrhage is not alarming, it is well to be satisfied with thorough cleansing of the wound, the introduction of drainage, and the adoption of the expectant measures already described. On general principles all

penetrating wounds should be enlarged, if necessary, to permit careful inspection, thorough cleaning, the removal of all foreign bodies, and the introduction of free drainage. If the position of the wound is such that a perforation of the intestine is strongly suspected, immediate laparotomy is indicated.

Gunshot Injuries.—If the patient does not react promptly or has progressive internal hemorrhage with increasing lumbar hematoma or intraperitoneal effusion, prompt exploration is demanded. This should be an abdominal incision, unless injury of the other viscera of the abdomen can be positively excluded and the hemorrhage is certainly extraperitoneal. After exposing the kidney, the surgeon must be guided by the conditions which are present. If only the cortex of the kidney has been wounded, gauze packing should be used to arrest hemorrhage and provide drainage. If the large blood-vessels are injured, if there are extensive wounds of the pelvis, or if the kidney is completely shattered, nephrectomy is indicated. In any case of doubt careful cleansing and drainage may be adopted.

Rents in the peritoneum, if clean, should be closed; but if the wound is a large one and much urine or blood has escaped into the abdominal cavity, it will be safer to perform nephrectomy and provide free drainage, preferably through the loin.

Collections of blood from the paranephric areas should be thoroughly evacuated. It is inadvisable to attempt the removal of collections of blood within the layers of the mesocolon. According to Keen, such a course usually results in extensive injury and infection, and therefore should not be undertaken.

Incised or Punctured Wounds.—In stab wounds, if the hemorrhage is very free or there is extravasation of urine, the opening should be enlarged and the organ carefully examined. Clean wounds of the kidney may be immediately sutured. Separated portions of kidney should be removed. If the kidney is partly shattered, a partial nephrectomy may be done. Clean-cut wounds of the pelvis may be sutured at once; ragged or contused ones should be partially closed and tubular drainage provided.

If the large vessels are cut, if the substance of the kidney itself or the pelvis is lacerated beyond the point where the organ will probably recover its vitality and resume its function, immediate nephrectomy should be done. The kidney must, of course, be replaced, if it has prolapsed through the wound.

Subparietal Injury.—In the treatment of a subparietal injury of the kidney an operation is indicated if there are evidences of persistent hemorrhage. Hemorrhage occurring into the paranephric area will become evident through the rapid formation of a hematoma in that region. If the blood is discharged into the peritoneal cavity, symptoms of internal hemorrhage will be associated with the signs of free fluid in the abdomen. The degree of hematuria is not always a reliable guide to the extent of an injury, but if large quantities of nearly pure blood are passed through the urethra, it may be taken as an indication that there is a serious injury which demands operation.

The abdominal route should be selected for the operation if there is any suspicion of visceral lesions or if the hemorrhage is intraperitoneal; otherwise, an oblique

lumbar incision should be used, and this, if required, may be extended anteriorly to a sufficient extent to permit the suturing of any rents in the peritoneum, a careful toilet, and the introduction of drainage, if indicated.

If the kidney is entirely pulpified or if the renal vessels need ligation in order to arrest hemorrhage, immediate nephrectomy must be done. Unless an abdominal incision has been made, when the uninjured kidney may be palpated, nephrectomy will have to be performed on the presumption that another kidney is present.

If during laparotomy the bladder is found filled with blood-clots, they should be expressed through the urethra. If the abdomen has not been opened, the clots in the bladder may be removed by irrigating with salt solution through a large-eyed or a two-way catheter or by means of one of the evacuators used in litholapaxy. In obstinate cases cystotomy (suprapubic in the male—vaginal in the female) may rarely be required.

When there are no urgent indications for a primary operation, it is desirable to place an ice-bag over the affected side and keep the patient as quiet as possible. If the intestines are distended, a high compound enema should be administered. Nothing but enough water to quench the thirst should be given by mouth for the first twenty-four hours. The bladder should be evacuated at regular intervals and appropriate measures should be adopted to avoid retention of urine.

When anuria occurs, the patient should be encouraged to drink freely of water; refrigerant diuretics, warm applications to the kidneys, and hot saline enemas should be used; the elimination of waste products should be assisted by hot packs. If the anuria persists for more than twenty-four to forty-eight hours, the kidney should be exposed by means of a lumbar incision and the calyces and pelvis opened.

When there are no urgent indications for primary operation in a case of sub-parietal injury of the kidney, the expectant plan of treatment already outlined should be continued. If in the course of a number of days there is evidence of a considerable collection of fluid in the paranephric area, a lumbar incision should be made immediately and the parts should be drained. If at this time the kidney is found to be hopelessly injured, it should be extirpated. Such an exploratory lumbar incision should not be postponed until septic symptoms occur.

In the absence of a considerable collection of fluid in the lumbar region, any evidence of an infectious process in the retroperitoneal tissues demands lumbar incision and drainage.

If there is any doubt as to the propriety of a primary operation in cases of kidney rupture, an exploratory incision should be made. This is less dangerous than an uncontrolled hemorrhage. A partial nephrectomy up to one-third of the kidney is perhaps justified, and the results are encouraging; the mortality is 33 per cent. From an analysis of his cases, Keen says: "It is especially to be noted that the great mass of recoveries in rupture of the kidney are the slighter cases; the graver ones do not recover unless operation is done." In any case, therefore, with severe or dangerous symptoms, the surgeon should lean toward exploration, and in severe

lacerations toward early nephrectomy. It adds little to the risk and will probably save a considerable proportion of lives.

ABNORMALLY MOVABLE KIDNEY. FLOATING KIDNEY. NEPHROPTOSIS.

In health the kidneys ascend with expiration and descend with inspiration, the range of mobility varying from 1 to 1½ inches and being greater in the female than in the male.

Abnormal mobility exists in different degrees, and it might be said in different kinds. The kidney may be movable behind the peritoneum to an unusual degree, so that half to two-thirds of it is palpable, or it may move entirely away from the costal margin and advance anteriorly and push up or "float" toward the abdominal wall.

A kidney that is palpable for one-half to two-thirds of its extent is spoken of clinically as a "movable" kidney, while one that can be palpated throughout its extent and shows a tendency to ride forward in the abdominal cavity has been designated by Morris as a "floating" kidney.

This is not the anatomic distinction. Anatomically a floating kidney is a congenital anomaly, having a distinct peritoneal attachment or a mesonephron. Because, however, a kidney which has no mesonephron may be just as movable behind the peritoneum and may float as far anteriorly as one that has, the terms must be used in a clinical and not in an anatomic sense.

Frequency.—The frequency of nephroptosis in women is variously estimated by different authors. Noble¹ has stated that it occurs in 25 per cent. of women the subject of gynecologic diseases. From 10 per cent. to 15 per cent. of Beyea's² gynecologic patients are affected. Harris³ saw seventy-one cases of movable kidney in one hundred and twenty-six women examined consecutively. Hahn⁴ found eighteen in one hundred cases. The proportion of cases noted by any investigator depends on the class of patients he examines, his methods of diagnosis, and his conception of what constitutes an abnormally movable kidney.

Etiology.—Movable and floating kidney has been ascribed to many causes: pregnancy, tight lacing, emaciation with the absorption of the perirenal fat, traumatism, congenital malformation of the renal fossa, etc. Equally reliable observers reach different conclusions in a consideration of this question. Thus, Hahn examining one hundred women, thirty-one childless and sixty-nine parous, found

¹ Noble, Charles P.: "Movable Kidney," *Gaillard's Med. Jour.*, 1895, vol. lxi, p. 59; "Some Further Observations Concerning Movable Kidney," *Amer. Jour. Obst.*, 1897, vol. xxv, p. 63; "Nephrorrhaphy," *Jour. Amer. Med. Assoc.*, 1900, vol. xxxv, p. 1517; "The Ultimate Results of Nephrorrhaphy," *Internat. Med. Mag.*, 1902, vol. xi, p. 145; "Some of the More Unusual Results of Movable Kidney," *N. Y. Med. Jour.*, 1904, vol. lxxix, p. 341.

² Beyea, H. D.: "The Significance and Treatment of Floating Kidney in Women," *Amer. Med.*, 1901, vol. ii, No. 21.

³ Harris, M. L.: "The Influence of Trauma in the Production of Movable Kidney," *Jour. Amer. Med. Assoc.*, 1904, vol. xlii, p. 411.

⁴ Hahn, E.: "Die operative Behandlung der beweglichen Niere durch Fixation," *Cent. f. Chir.*, 1881, Bd. viii, Nr. 29.

eight movable and eight floating kidneys. They all occurred in the women who had borne children, and he therefore concludes for this and other reasons that pregnancy is the chief cause. Harris scouts the idea of nephroptosis depending upon pregnancy, having met a larger percentage of cases in nulliparous than in parous women. Of one hundred and twenty-six cases examined, there were fifty-six cases in which the kidney was not palpable and seventy-one in which it was movable; but the average number of children per woman was greater in the first class than in the second; out of one hundred and seven women with movable kidney, fifty-two had no children, while fifty-three had borne one or more.

Albarran ranks movable kidney with the stigmata of degeneracy. Harris, although he does not go that far, regards an alteration of the body form, viz., a contraction of the middle zone of the body, as the most potential predisposing factor in movable kidney.

Glénard¹ thinks floating kidney is but part of a general ptosis of the abdominal viscera—enteroptosis—due to an abnormally low insertion of their mesenteries or points of attachment. While this may apply to the very rare cases of floating kidney with a mesonephron, according to Ewald and H. Morris, it does not apply to ordinary cases.

Hahn believes that acute and chronic traumatism may be concerned in the production of nephroptosis. He mentions dancing, horseback-riding, and muscular exertion in a stooping position.

Harris, who critically examined forty-one cases of abnormally movable kidney in which there was a history of traumatism, could not find an actual relationship of cause and effect in any one of them.

The use of a corset has been mentioned as a cause of ptosis of the kidney. Trekaki (quoted by Hahn) examined one hundred Arabian women who used no means of compression of the waist; in thirty the lower third of the kidney was palpable, in nine the lower two-thirds, and in two the kidney floated.

It is the opinion of the authors that the difference between the frequency of floating kidney in the male and in the female may depend entirely upon the difference in the configuration of the renal fossa. In the man they are deep, narrowed below, and bean-shaped. In the woman they are shallow, and instead of being narrower below, especially on the right side, they are actually wider. The difference in the configuration of the renal fossa must be associated with the difference in body form mentioned by Harris. Morris also has noted that the type which suffers most frequently from this affection is the spare, slender, small-waisted woman with a long thorax.

Noble has been particularly impressed with the relation between the amount of perirenal fat and abnormal mobility of the kidney. In his experience rapid emaciation in women not confined to bed has been a factor in many cases.

Multiple pregnancies, diastasis of the rectus muscles, and relaxation of the abdo-

¹ Glénard, Frantz: "Les ptoses viscérales (estomac, intestin, rein, foie, rate) diagnostic et nosographie (entéroptose, hépatisme)." Paris, 1899.

minal wall may be contributing causes, but they are more closely related to enteroptosis than to nephroptosis.

It seems reasonable to believe in a small number of cases that traumatism has produced a floating kidney; especially when the left kidney is affected, the right organ being *in situ*.

Other causes have been noted, such as tumors about the upper pole of the kidney, downward displacement of the diaphragm by pulmonary disease, increase in the weight of the kidney as in hydronephrosis, etc., and high-heeled shoes which throw the body forward and produce a compensatory lumbar lordosis.

Pathology.—The kidney may be entirely healthy or it may be the seat of various diseases, which are either the result or the cause of the ptosis or purely accidental.

A certain degree of softness or flabbiness of the renal tissue, due to sacculation of the calyces from intermittent renal distention, is spoken of by H. Morris. It is seen in the cases of beginning hydronephrosis brought about by a twisting or a kinking of the ureter.

As a result entirely of faulty position and a periodic interruption of its normal discharge, the kidney may contain calculi or an abscess, or it may be the seat of any form of nephritis.

That pathologic mobility of the kidney may produce nephritis is indicated by the report of Edebohls, who found it in seventeen cases out of one hundred and eighty-six; in nine cases both kidneys were affected.

Tuberculosis has been found. Torsion of the pedicle sometimes results in congestion of the kidney and hematuria.

A displaced kidney may pull down the duodenum, and this in turn the bile-ducts, favoring gastric dilatation and disturbance in the biliary function. According to Edebohls, a ptosed kidney may press upon the ileocolic branch of the superior mesenteric artery, predisposing to congestion of the appendix and chronic appendicitis.

Symptoms.—The subjective symptoms of movable kidney are reflex and local. In many cases they are reflex and not at all characteristic. The most prominent reflex symptoms are nervousness, intestinal indigestion, distention of the bowel, palpitation of the heart, and cardialgia. Neuralgic areas are met with frequently and the pain is referred most often to the abdomen and the region of the heart.

One of the common local symptoms is a sensation of weight or dragging, which is noticed after standing or walking for a long time. In certain cases the patient finds the ptosed kidney and recognizes it as a source of annoyance and even pain. A common symptom is inability to sleep lying on the side opposite the affected kidney.

Constant pain in the kidney itself is not a frequent symptom, but acute attacks of severe pain occur in many of the well-marked cases, being the result of torsion of the pedicle of the kidney which obstructs the blood-vessels, the ureter, or both.

Such attacks are spoken of as renal or Dietl's crises.¹ The patient is seized with sharp, agonizing pain, and there is great tenderness in the lumbar and hypochondriac regions. As a rule, the kidney rapidly enlarges and can be more or less distinctly mapped out, the increase in size being due either to an extreme congestion of the blood-vessels or to an acute hydronephrosis, or to both. The attack is accompanied usually by marked nausea and vomiting.

During renal or Dietl's crises the urinary excretion is diminished, and contains albumin, casts, or even blood. These substances disappear afterward, and there is apt to be an increased discharge of urine, especially if an acute hydroureter or hydronephrosis has developed. Between the attacks of renal colic the urine may be entirely normal. In a single instance one of us observed hematuria, the result of chronic congestion from torsion of the renal vessels. Congestion of the kidney is responsible also for the albumin and the hyaline casts which sometimes appear in the urine.

In rare instances intestinal obstruction, jaundice, or dilatation of the stomach has occurred from pressure or traction upon the duodenum.

Diagnosis.—The frequency with which the diagnosis of nephroptosis is made depends to some extent upon the view of the examiner as to what constitutes an abnormal range of mobility.

The kidney normally is not palpable, or at least no more than its lower border can be felt. Nephroptosis has been said to exist in three degrees:

1. The lower half of the kidney is palpable.
2. The greater part or the whole of the kidney is palpable.
3. The whole kidney descends below the border of the ribs.

It has been observed by Clark and one of the authors that the kidney has a normal range of mobility which varies between 3 and 5 cm. This has been determined by direct intra-abdominal palpation during celiotomy. Many cases of the first degree, therefore, must remain of questionable importance. As a rule, not much significance need be attached to any case in which the kidney cannot be easily brought below the costal margin.

Neurasthenic and hysterical symptoms are often associated with loose kidney. It is an important point in judging a case to separate the nervous symptoms which are due to the kidney from those due to enteroptosis and others which may exist coincident with but independent of the renal displacement.

Most of the writers upon this subject examine for movable kidney with the patient lying on her back or the side opposite the displaced organ. The thighs of the patient are flexed and elevated over pillows. The examiner stands upon the side involved and places the palmar surface of his outer hand under the lower costal margin and presses forward. The other hand is applied with its palmar surface upon the abdominal wall, the finger-tips lying just below the ribs and outside of the rectus muscle. The patient is now directed to inspire deeply and to

¹ Dietl: "Wandernde Nieren und deren Einklemmung," *Wiener med. Wochenschr.*, 1864, Bd. xiv, Nr. 36, 37 und 38, S. 563, 579 und 592.

minal wall may be contributing causes, but they are more closely related to ptosis than to nephroptosis.

It seems reasonable to believe in a small number of cases that trauma produced a floating kidney; especially when the left kidney is affected, the organ being *in situ*.

Other causes have been noted, such as tumors about the upper part of the kidney, downward displacement of the diaphragm by pulmonary disease, the weight of the kidney as in hydronephrosis, etc., and high-heeled shoes throw the body forward and produce a compensatory lumbar lordosis.

Pathology.—The kidney may be entirely healthy or it may be affected by various diseases, which are either the result or the cause of nephroptosis.

A certain degree of softness or flabbiness of the renal tissue, due to the calyces from intermittent renal distention, is spoken of by some authors in the cases of beginning hydronephrosis brought about by obstruction of the ureter.

As a result entirely of faulty position and a period of inactivity, discharge, the kidney may contain calculi or an abscess, or any form of nephritis.

That pathologic mobility of the kidney may produce the report of Edebohls, who found it in seventeen out of eighty-six; in nine cases both kidneys were affected.

Tuberculosis has been found. Torsion of the kidney has been reported, gestation of the kidney and hematuria.

A displaced kidney may pull down the duodenum, favoring gastric dilatation and disturbing the function of the ducts, according to Edebohls, a ptosed kidney may pressure the mesenteric artery, predisposing to congenital or acquired appendicitis.

Symptoms.—The subjective symptoms are noted in many cases. In many cases they are reflex and not direct. Reflex symptoms are nervousness, palpitation of the heart, and cardiac asthma, and the pain is referred most often to the back.

One of the common local symptoms is noticed after standing or walking. The patient finds the ptosed kidney and refers the pain to it. A common symptom is inability to walk. The kidney.

Constant pain in the kidney is not common. Of severe pain occur in many cases. Pain of the pedicle of the kidney is not common. Pain at the kidney, and albumin or casts of blood

ports the patient to respire. The patient is only, and his right hand is a conjoint manipulation. The patient palpated, and, if present, the patient noted are the shape and size of the kidney beneath the margin of the ribs. The examiner's hands no longer support the kidney. As a rule, the patient will complain of pain associated with a feeling of faintness. As mentioned by Hahn, a ptosed kidney may cause a "liver" lobe of the liver and a tensely contracted and abnormally movable and enlarged kidney. It is a source of error.

In a small minority of cases of movable kidney the kidney is abnormally movable kidney, even marked ptosis. On the other hand, a moderate ptosis may cause a pain only indicated, but is urgently demanded by such as renal crises, intermittent hydro-nephrosis, and albumin or casts of blood

be advisable also when the ptosed kidney is recognized as a movable tumor.

Especially when the kidney is displaced only to a moderate degree, the effect of medical and hygienic treatment may be proved curative in certain cases. The patient remains upon her feet, the increase of perirenal fat may be effected, the diet may be improved, others, hygienic measures, the deposit of fat,

is advocated by many authors. In the cases which have benefited. A physician herefrom for eight years of a belt and pad, and yet the catarrh to disappear and also the patient.

A straight-front variety is a much more common one and they are especially useful in cases of ptosis of the kidney. By supporting the abdominal wall the kidney. The use of a straight-front belt will help to differentiate between symptoms of ptosis and those caused by enteroptosis, neurasthenia,

When the reflex symptoms are distressing and symptomatic relief. Non-operative treatment will usually fail in the kidney is displaced to the third degree. Operation is indicated if the patient is pronouncedly neurotic or hysterical. Should the symptoms directly referable to the kidney itself demand operation in such a case, the prognosis should be guarded, and the patient herself, her family, should be made to understand that the operation will relieve but not the hysterical symptoms.

HYDRONEPHROSIS, URONEPHROSIS, CYSTONEPHROSIS, SAC-KIDNEY OF KÜSTER.

Etiology.—Hydronephrosis may be congenital or acquired.

The *congenital* form is present at birth or soon after. There may be malformation of the calyces or the pelvis of the kidney, but the usual location of a congenital obstruction is the ureter. The latter may end blindly or it may be the seat of a complete or a partial stricture. Malformation may be present at the ureterovesical

follow this with a quick, relaxing, sighing expiration; during the latter the fingers gently press the abdominal wall inward and the whole hand is moved downward. In this way the kidney brought down by deep inspiration, if abnormally movable, may be felt slipping upward between the fingers. In order to determine whether it can be palpated *in toto*, the thumb of the posterior hand just before the expiratory effort may be pushed deeply under the costal arch anteriorly, thus preventing the return of the kidney during expiration and enabling the examiner to palpate its surface at leisure. All authors speak of the uncertainty of this method of examination and advise repeated examinations at intervals of several days, in case the first examination is negative. Having the patient cough or strain will sometimes bring the kidney down.

Owing to the defects of the usual method of examination, Noble devised a plan of examining the patient in the erect posture. This method is not only very trustworthy in determining whether or not the kidney is ptosed, but it affords a reliable means also of learning the range of mobility. With the patient in the dorsal position an abnormally movable kidney, as a rule, resumes its normal position and is displaced only by inspiratory effort; in the erect posture, on the other hand, it becomes displaced by gravity. The examination should be made as follows:

The patient's clothing should be loosened, all bands about the waist unfastened, and the skirts supported by a nurse or assistant, so that the patient will not be embarrassed with the fear that her clothing will fall off. She should then stand before a table or a desk of convenient height—about 30 inches—with the examiner seated on her right. The patient then bends forward from the hips, and supports some of her weight by resting her hands on the table. She is directed to respire regularly, care being taken to relax herself thoroughly during expiration. The examiner's left hand is placed against the lumbar region posteriorly, and his right hand in a corresponding position in front of the kidney. By a conjoint manipulation the region between the two hands can be carefully palpated, and, if present, the kidney is easily recognized. The points to be noted are the shape and size of the kidney, its ready displacement upward beneath the margin of the ribs and return to its former location as soon as the examiner's hands no longer support it. When the kidney is compressed, as a general rule, the patient will complain of tenderness or pain of a peculiar character, often associated with a feeling of faintness or nausea. Upon the right side, as mentioned by Hahn, a ptosed kidney must be differentiated from a movable "Schnur" lobe of the liver and a tensely filled gall-bladder, and on the left side from an abnormally movable and enlarged spleen. Tumors of the bowel might also be a source of error.

Indications for Operation.—Only a small minority of cases of movable kidney require nephropexy. Many cases of abnormally movable kidney, even marked cases, produce no symptoms. On the other hand, a moderate ptosis may cause a great deal of suffering. Nephropexy is not only indicated, but is urgently demanded in cases having marked local symptoms, such as renal crises, intermittent hydro-nephrosis, constant pain or soreness in the kidney, and albumin or casts of blood

in the urine. Operation may be advisable also when the ptosed kidney is recognized by the patient as an annoying movable tumor.

When the symptoms are reflex, especially when the kidney is displaced only to the first or the second degree, it is wise to try the effect of medical and hygienic treatment. In our experience the rest cure has proved curative in certain cases and obviated the necessity for operation. When the patient remains upon her back, the kidney returns to its normal position, and with the increase of perirenal fat brought about by rest and forced feeding a permanent cure may be effected, especially in cases of the first or even of the second degree. In others, hygienic and tonic management has improved nutrition and increased the deposit of fat, and relief has been obtained.

The treatment of movable kidney by means of belts and pads is advocated by some, including Treves. This treatment seems irrational, and the cases which have come under the observation of the authors have not been benefited. A physician who suffered with nephroptosis and had hematuria therefrom for eight years stated that he could keep his kidney in position by means of a belt and pad, and yet fixation of the kidney by operation caused the hematuria to disappear and also demonstrated the inefficiency of the previous treatment.

The use of special corsets of the so-called straight-front variety is a much more satisfactory means of palliative treatment, and they are especially useful in cases of enteroptosis associated with movable kidney. By supporting the abdominal contents some indirect support is afforded the kidney. The use of a straight-front corset is indicated in cases having well-marked nervous symptoms. The effect of the support which the corset affords will help to differentiate between symptoms which really are due to nephroptosis and those caused by enteroptosis, neurasthenia, and hysteria.

Nephropexy is indicated when the reflex symptoms are distressing and symptomatic treatment has given no relief. Non-operative treatment will usually fail in cases of this sort when the kidney is displaced to the third degree. Operation should be avoided when the patient is pronouncedly neurotic or hysterical. Should the local symptoms directly referable to the kidney itself demand operation in patients of this type, the prognosis should be guarded, and the patient herself, or even better her family, should be made to understand that the operation will remove the local but not the hysterical symptoms.

HYDRONEPHROSIS, URONEPHROSIS, CYSTONEPHROSIS, SAC-KIDNEY OF KÜSTER.

Etiology.—Hydronephrosis may be congenital or acquired.

The *congenital* form is present at birth or soon after. There may be malformation of the calyces or the pelvis of the kidney, but the usual location of a congenital obstruction is the ureter. The latter may end blindly or it may be the seat of a complete or a partial stricture. Malformation may be present at the ureterovesical

phies more or less completely, until at last the kidney is represented by an irregular cystic tumor, in whose walls are found the remnants of the original kidney tissue.

While many cases in their ultimate stage consist of actual unilocular sacs, others are multilocular, the individual cysts usually communicating with each other, however, by very small openings. These openings represent the mouths of the erstwhile calyces and have a tendency to contract and form a cicatricial ring. The wall of the sac may be thin and transparent in the area representing the original kidney pelvis; or it may be thick and have a turbid white color; or it may be very thick and contain deposits of lime.

The ureter may adhere to the sac wall for some distance. The adhesions may be separated in early cases, but not in old ones.

The ureter may run for quite a distance in the wall of the sac, to terminate at a point high over its lower pole. A valve formation is often present, so that the ureteral opening is difficult or impossible to discover from within the sac, even in removed specimens. Sometimes the opening can be found only by means of sounding or slitting the ureter from below.

The hydronephrotic sac may be no larger than the normal kidney, or it may be sufficiently large to form a well-marked tumor in the kidney region. Rarely it may be smaller than the normal kidney, or of such a size that it occupies a great part of the abdominal cavity.

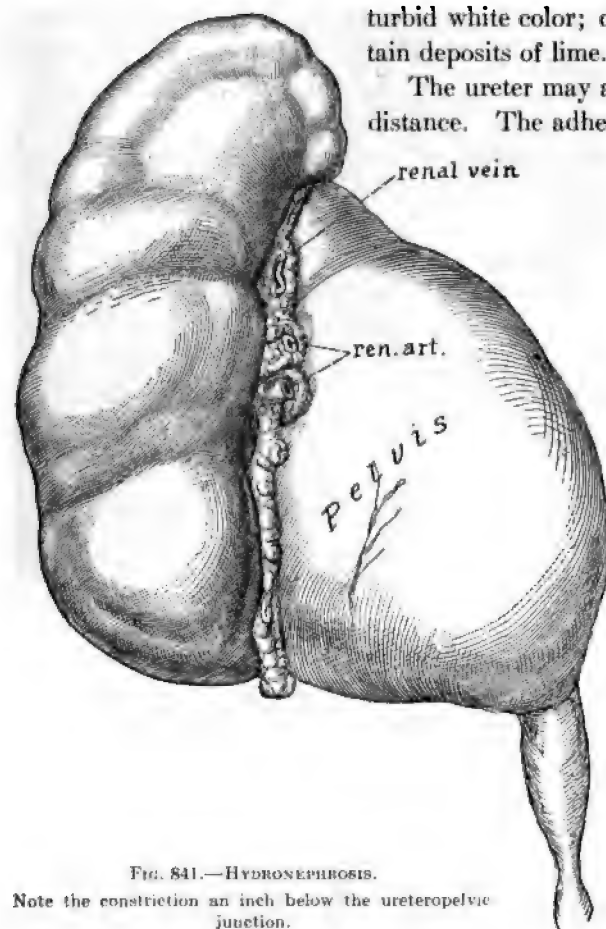


FIG. 841.—HYDRONEPHROSIS.

Note the constriction an inch below the ureteropelvic junction.

Contents of the Kidney Sac.—Except in recent cases, hydronephrotic fluid does not have the characteristics of normal urine; it is practically little more than water containing sodium chlorid and a few desquamated epithelial cells and fat droplets. The urine in fresh cases loses its solid constituents *pari passu* with the gradual atrophy of the kidney parenchyma. The specific gravity sinks to 1.010 or even to 1.0065. The reaction becomes weakly acid or neutral. The urine may be watery or of a dark yellow, yellowish-brown, or greenish color; it may

be a little turbid or entirely clear. Fresh blood colors the fluid a light or dark red; old blood gives it a chocolate or coffee color. The contents may be tenacious colloid material or thick and pasty, like white paint or putty; numerous cholesterol crystals are sometimes found.

Symptoms.—The subjective symptoms which present themselves before the appearance of a tumor vary to a considerable extent, being influenced by the cause and the mechanics of the distention. In a large number of congenital cases there are no symptoms until the kidney tumor is found.

In the intermittent form associated with abnormal mobility of the kidney and a kinking of the ureter, the patient will suffer from repeated attacks of renal colic, followed by an increased discharge of urine as the pain subsides. The development of hydronephrosis due to ureteral or to kidney stone is usually preceded or accompanied by the symptoms of those conditions. Cases of hydronephrosis which are secondary to urethral stricture, enlarged prostate, pelvic carcinoma, etc., usually present the associated symptoms of the primary lesion. Distention of the kidney from non-inflammatory or non-malignant external pressure on the ureter, as, for example, in the case of a subperitoneal fibroid or a pregnant uterus, may be quite painless until a considerable size has been attained. In the intermittent variety of hydronephrosis there may be gastro-intestinal symptoms, such as digestive disturbance, nausea, anorexia, and constipation. Sometimes the patient will have complained of a feeling of pressure or uneasiness for a time before the tumor is found.

The position of the tumor in hydronephrosis will depend upon its size and its mobility. In the case of a small tumor with no increase of mobility, the enlarged kidney will be found in its normal position. When the tumor is mobile and is displaced downward, it will usually occupy a position in the ileocostal area, pressing the abdominal parietes forward and outward. It may be evident upon inspection. The colon lies in front of the tumor, unless the latter is very large, when the bowel may be displaced to one side and the tumor be in direct relation with the anterior abdominal wall. In very large collections of fluid, the enlarged kidney may extend beyond the median line of the abdomen.

On palpation the tumor may be flaccid or tense. It is very often slightly irregular in outline and may even be lobulated. Fluctuation is present if the tumor is of large size, the sac tense, and the walls thin. Some flaccid tumors cannot be distinctly outlined. If the hydronephrosis is small and tense, it may feel like a solid tumor.

During palpation the tumor may suddenly become soft and yielding, and the patient may at once express a desire to urinate, when an unusually large amount of urine may be passed from the bladder. In such a case pressure has overcome the obstruction and the hydronephrotic fluid has been expressed through the ureter. The same phenomenon may occur spontaneously in intermittent hydronephroses when the obstruction is valvular and very wide distention of the sac opens the valves. The hydronephrotic sac occasionally ruptures, either spontaneously or from pres-

sure or trauma. Such a possibility should always be remembered during palpation.

There is often a feeling of fullness and discomfort in the tumor, and if the sac becomes tense, there is a more acute pain, such as occurs in overdistention of the bladder. Frequent micturition and alternating oliguria and polyuria are noted in some cases.

Diagnosis.—The tumor of hydronephrosis must be differentiated at times from cystic degeneration of the kidney, cystic distention of the gall-bladder, cystic tumor of the ovary, and echinococcus cyst of the liver. It may also be resembled by pyonephrosis, solid tumor of the kidney, and splenic tumor. The usual relation of the colon to a kidney tumor may serve to distinguish it from an enlargement affecting an intraperitoneal organ. Distention of the colon with air will sometimes be useful in making out the position of the bowel in front of the kidney.

An ovarian cyst is usually of greater size, and its attachments to the broad ligament can often be determined by rectal palpation while the cervix is pulled downward with a tenaculum. Hydatid cysts of the liver are directly continuous with that organ, usually occupy a somewhat higher position than kidney tumors, and are more or less immobile.

It is very easy to mistake a cystic gall-bladder for a hydronephrotic kidney. Careful examination will often suffice to distinguish a connection between the liver and the tumor, in which case the diagnosis becomes clear. In the case of a cystic gall-bladder, the enlargement is directly in relation with the abdominal wall and does not project in the loin like a renal enlargement.

Catheterization of the ureter on the affected side will frequently be of the greatest aid in diagnosis by disclosing an obstruction of the ureter. If the catheter can be pushed past the point of obstruction into the hydronephrotic sac, the rapid flow of fluid and the diminution in the size of the tumor will be absolutely diagnostic. When the obstruction is high up at the ureteropelvic junction, it is difficult to pass, but the absence of excretion from this side in a completely closed sac is significant. A positive diagnosis in some cases can only be made after an exploratory incision.

Prognosis.—The ultimate fate of a hydronephrosis depends upon the extent to which the kidney has been damaged, the removability of the exciting cause, and upon the health of the opposite kidney. If the condition has developed slowly and the other kidney has increased its functional activity, life may not be endangered for years. This fact is proved by cases of hydronephrosis in extreme old age. If the second kidney fails or if it too becomes hydronephrotic, then uremia may rapidly supervene. In six out of forty-seven cases collected by Morris the tumor disappeared spontaneously. Infection of a hydronephrotic sac may convert it into a pyonephrosis. Rupture of the sac may occur as a result of traumatism and be followed by hemorrhage or peritonitis.

Treatment.—The treatment of a case of hydronephrosis should be based upon the position and the cause of the obstruction. It is evident that there should be

two objects in view: first, removal of the cause of obstruction; second, treatment of the damaged kidney.

Obstruction may be relieved according to its cause by plastic operations on the kidney pelvis and ureter, nephropexy, removal of calculi, resection or gradual dilatation of a constricted part of the ureter, prostatectomy, removal of pelvic tumors, urethrotomy, etc.

Evacuation of the fluid may be attempted by massage, ureteral catheterization, tapping, and nephrotomy. Careful replacement of a displaced hydronephrotic sac, combined with gentle massage, may be successful rarely in evacuating the fluid. In case the condition results from ptosis of the kidney and kinking of the ureter, a re-accumulation of fluid may possibly be prevented by supporting the kidney with a suitable bandage or binder. In many cases, however, the tumor is so painful or so tense that any effort at replacement or massage would cause great suffering and be quite dangerous. Nephropexy is much more reliable in such cases and is indicated. Ureteral catheterization will sometimes be successful in evacuating a hydronephrotic tumor.

Tapping has frequently been used in the past as a means of relieving distention, and in some cases after repeated tapping the tumor has disappeared. At the present time, however, this procedure should be reserved for desperate cases in which nothing more dare be attempted; otherwise an exploratory incision and puncture is infinitely preferable and may be done under local anesthesia, if a general anesthetic is undesirable. Before tapping a hydronephrotic sac the colon should be inflated so as to determine its position accurately. The needle should be thrust into the sac half-way between the last rib and the crest of the ilium, on a line posterior to the colon—usually two and a half inches back of the anterior superior spine of the ilium.

A stricture in the lower part of the ureter may be cured sometimes by the passage of graduated ureteral catheters or bougies. With an improved form of cystoscope this is an easy and safe procedure and may be carried out with the patient in the ordinary dorso-sacral posture. It is preferable to have the bladder distended with boric acid solution rather than with air. Preliminary irrigation and the use of fluid distention reduces the danger of infection from ureteral catheterization to a minimum. These statements apply especially to the female; ureteral catheterization in the male is decidedly more difficult and will be of very limited service in the treatment of hydronephrosis. The ureteral instruments must be passed very gently in order to avoid puncture of the ureter at the site of the obstruction.

Nephropexy may cure cases of hydronephrosis due to a ptosis of the kidney and a kinking of the ureter. In relying upon this method for a given case, care must be exercised to make sure that there is no other cause of obstruction. It will often be advisable and necessary to combine plastic operations on the kidney pelvis and ureter with nephropexy, and in any case in which there is doubt as to the cause of the obstruction, the kidney pelvis should be freely opened and the ureter sounded from above.

When the obstruction lies in the kidney pelvis or near the upper part of the ureter, it is advisable in the majority of cases to expose the kidney by means of a lumbar incision and then to be guided as to further operative procedure by the conditions which are found in the individual case.

When the tumor is not of great size and there is no fixation of the kidney, it should be separated carefully from its surroundings and delivered through the incision.

The mechanics and the pathologic anatomy of the individual case may now be determined by inspection and palpation of the kidney and ureter externally; or by inspection and probing after splitting the kidney into the pelvis; or by opening the pelvis itself.

In old and very extensive cases, and in those in which the kidney substance is entirely destroyed, so that the organ is useless, immediate nephrectomy may be done. As long, however, as the obstructed kidney has some secreting tissue, and especially if the other kidney is affected or its functional activity is undetermined, nephrectomy must not be considered as a primary operation.

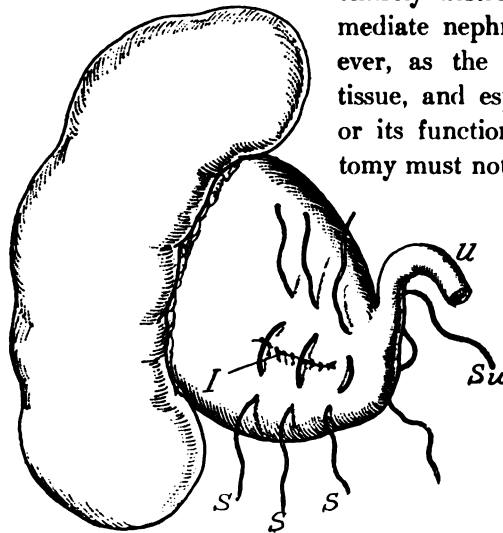


FIG. 842.—ISRAEL'S OPERATION OF PYELOPLASTY.

Observe how the ureter is carried up on the surface of the distended pelvis, and the kink at the uretero-pelvic junction. *I*, Shows sewed-up incision in posterior wall of pelvis; *S*, sutures for pyeloplasty; *Su*, suture for correction of ureter; *U*, ureter.

ureteral opening; the flow of urine through the ureter is resumed, and the fistula closes.

In seeking the cause of the obstruction, great difficulty will often be experienced in locating the ureteral orifice in the kidney pelvis. The attempt should not be prolonged; instead, the original lumbar incision should be lengthened, the ureter exposed and opened below, and a sound passed through it upward into the kidney pelvis.

If the obstruction is found at the junction of the ureter and pelvis, the valve formation may be cured by incising it longitudinally and bringing the margins of the incision together in a transverse direction (Fig. 843).

In the case of large tumors it is difficult to detect the ureteral orifice in the kidney pelvis or to palpate the ureter externally. If an attempt to do so fails, the best plan is to perform nephrotomy, evacuate the fluid, and drain the kidney pelvis. After the sac has retracted, another operation may be undertaken, if required, to relieve the obstruction and close the fistula.

Nephrotomy alone sometimes cures a hydronephrosis. The relief of tension in the sac wall does away with the valvular action of the

When the configuration of the sac is such that the ureteral orifice is high up, the angle between the sac and the ureter may be lessened, and a lower position may be secured for the latter by excising a portion of the sac wall or by adopting Israel's¹ plan of pyeloplication (Fig. 842). Küster has overcome these difficulties by excising the upper end of the ureter and implanting it into the pelvis lower down. This would be especially desirable when the upper end of the ureter is the seat of a stricture.

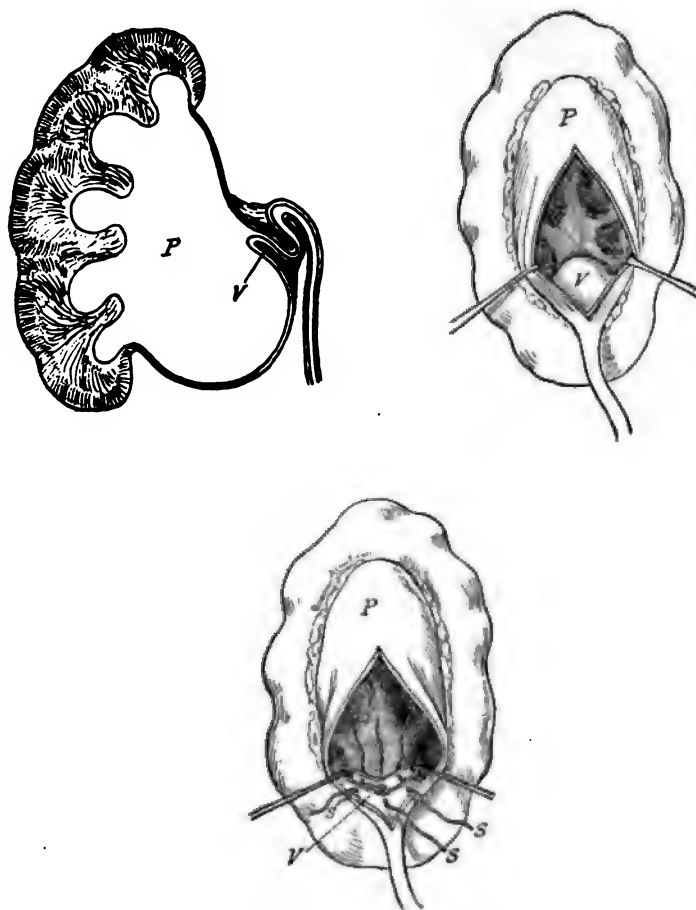


FIG. 843.—ISRAEL'S PLAN FOR THE CORRECTION OF A FALSE VALVE AT THE JUNCTION OF THE KIDNEY PELVIS AND THE URETER.

P, Pelvis of kidney; *V*, valve of ureter; *S*, sutures.

When hydronephrosis is due to kidney or ureteral stone, its treatment becomes that of nephrolithiasis. After removing the calculus from the kidney or the ureter as the case may be, a careful investigation should be made in order to determine whether the obstruction has been entirely overcome. When it is certain that no calculi still remain in the kidney or ureter, the course of procedure depends on the

¹ Israel, Jas.: "Chirurgische Klinik der Nierenkrankheiten," Berlin, 1901.

degree to which the kidney has been damaged. Because of the tendency of both kidneys to be affected in nephrolithiasis, nephrectomy should not be considered as a primary operation. In certain cases even after the removal of the calculi, when obstruction is absolute from ulcerative and cicatricial changes and the opposite kidney is healthy and has been performing the work of both organs satisfactorily for some time, nephrectomy may be indicated. As a rule, in such cases the hydronephrosis has become a pyonephrosis. Drainage should be used if the case is septic or there is still some obstruction. The reader is referred to the sections on the treatment of kidney stone and the operations of nephrotomy and nephrolithotomy.

If the cause of obstruction in a case of hydronephrosis is found to be in the ureter at some distance from the kidney, the latter should be approached retroperitoneally. (See Chapter XLVIII for plans of treatment.)

When the kidney is sacculated in a case of hydronephrosis and instead of one large cavity there are a number of smaller ones communicating by narrow necks with the kidney pelvis, the plan of operation should be that of Fenger. After nephrotomy the partition walls between the smaller sacs are divided so that all parts of the cystic kidney communicate with each other. Hemorrhage is controlled by digital pressure, the cautery, sutures, and gauze tampons. Drainage is maintained until any subacute inflammatory process in the kidney has subsided, and until obstruction to the ureter has been overcome either by a plastic operation or by repeated soundings. The two halves of the kidney may then be freed from adhesions and reunited.

NON-TUBERCULOUS INFLAMMATORY LESIONS OF THE KIDNEY—PYELONEPHRITIS, PYONEPHROSIS, EMPYEMA OF THE KIDNEY PELVIS, AND KIDNEY ABSCESS.

An infection may reach the kidney: either (1) through the blood—descending or hematogenous infection; or (2) from some point in the urinary passages—ascending infection; or (3) it may come from the direct extension of an infection from a neighboring organ, as, for example, an appendicitis, a vertebral caries, or an abscess of the liver or the spleen. Infection of the kidney through the blood may follow whenever bacteriemia occurs in such diseases as pneumonia, typhoid fever, diphtheria, osteomyelitis, puerperal sepsis, erysipelas, phlegmons, furuncles, infected wounds, etc.

An ascending infection from some point in the urinary tract may occur through the lymphatics and the veins in wounds, inflammations, and ulcerations along the course of the ureter. Ascending invasion usually is taken to mean an extension of infection from the bladder along the mucous membrane of the ureter to the kidney pelvis.

The organisms which take an active part in suppurative diseases of the kidney are the *streptococcus pyogenes aureus*, the *staphylococcus pyogenes aureus*, the *proteus vulgaris*, the *bacterium coli commune*, and the *gonococcus*.

The *streptococcus* is the organism most often concerned in a descending or hematogenous infection. The *staphylococcus* and the *gonococcus* may also reach the kidney through the blood. As already indicated, the *pneumococcus*, the *bacillus typhosus*, and others, cause hematogenous infection of the kidney.

The organisms most apt to produce ascending infection are those which cause decomposition of the urine and are motile. Of these, the *bacterium coli commune* is by far the most frequent. According to Küster, in about two-thirds of all cases of infection it occurs either in pure culture or mixed with other bacterial forms. The organism is slightly motile. Urine containing the bacillus in pure culture is offensive, has a peculiar opalescent appearance, and possesses, without exception, an acid reaction, which it retains for days.

The *proteus vulgaris* quickly makes the urine alkaline; because of its motility and rapid growth it easily gains access to the kidney pelvis. Urine containing this organism has a disgustingly foul odor. Whether it is the primary cause in all cases in which it is found in pure culture is questionable; by its quickness in growth it may supplant the primary organism.

Gonococcus infections of the urethra and bladder are so common that one would suppose gonococcus infection of the upper urinary passages to be frequent. The gonococcus, however, has not often been recognized in cultures taken from the pelvis of the kidney or the upper ureter. In the course of ascending infections of the urinary tract, apparently due to the gonococcus, fermentation and decomposition of the urine are frequent, and as the gonococcus never causes decomposition of the urine, this fact would seem to indicate that it alone is not the cause of such infections. According to Küster, the possibility of an ascending infection by the gonococcus is very slight, while the possibility of its metastatic deposit in the kidney cannot be doubted. The chief rôle played by the gonococcus is undoubtedly found in the alterations favorable to the growth of other bacteria which it produces in the lower urinary passages. For example, stricture results in a stasis of the urine favoring the growth of other organisms and their ascension of the ureter by their own motility or by reflex peristalsis.

The *staphylococcus pyogenes aureus* is frequently found in the bladder, but seldom in a kidney abscess, and then only from infection through the blood. The urine when it contains this organism is commonly alkaline, or at least neutral. The *streptococcus pyogenes* is commonly associated with severe general symptoms and metastatic pyemic abscesses. Infection usually occurs by the blood, but ascending infection is possible. The pure culture is not so often found as in the case of the staphylococcus; when it occurs in pure culture, the urine is acid.

The mere presence of bacteria in the lower urinary passage is not all that is requisite for an ascending infection. Added to this usually there is a stasis of the urine in the ureter or bladder. This obstruction to the urinary outflow may be found in strictures or in sacculations of the ureter, bladder, or urethra. The most frequent cause in young men is a gonorrheal stricture; in old men, an enlarged prostate; in women, a kinked ureter associated with floating kidney, or a compressed

ureter associated with pregnancy or a tumor. Instrumentation in such cases frequently leads to slight abrasions of the mucosa, which favor bacterial invasion. The virulence of the particular organism and the resistance of the individual are factors of much importance in the pathogenesis of both ascending and descending infections.

Pathologic Anatomy.—The kidneys often give evidence of a previous cirrhosis.

The *descending hematogenous form of pyelonephritis* is usually bilateral. In the severest form death occurs in a few hours, and the only changes which occur are congestion and some ecchymosis beneath the capsule. In cases of slightly longer duration marked hemorrhages occur throughout the kidney. In less acute forms minute abscesses are found scattered through the cortex of the kidney. They may appear like fine dots arranged in rows in the form of a wedge with its base toward the fibrous capsule. The surrounding and intervening tissue is infiltrated with blood. The epithelium of the cortical tubules undergoes degeneration. At a later stage abscesses are found throughout the cortex, even so near the surface that they cause the capsule to bulge; sometimes they break through into the perinephric tissue. The medullary part of the kidney next becomes involved. Individual abscesses form, coalesce with others, and finally the kidney is honeycombed with abscess cavities having inflamed and degenerated kidney parenchyma between them. The pus finally breaks into the kidney pelvis.

Pyelitis ensues and the ureter becomes obstructed either by the congestion and swelling of the mucous membrane, as already noted (p. 766), or by masses of broken-down kidney tissue, or by actual inflammatory and cicatricial processes at the mouth of the ureter or in its upper part. The kidney pelvis distends with urine and pus, and this increase of tension favors the destruction of the septa between the abscess cavities in the kidney substance, so that the entire structure may become converted into a single pus sac.

In *ascending pyelonephritis* alterations are usually found in the bladder and ureter. The mucous membrane of each in mild cases exhibits a vivid red color; it is swollen, somewhat loosened from the underlying tissue, and covered with muco-pus. In the severer forms the mucosa has a dark red color and here and there exhibits patches of ulceration. The ureters may show alternate dilatation and contraction, or they may be fixed by inflammatory deposits about them. In some cases the alterations in the ureter are insignificant. The mucosa of the kidney pelvis is injected, swollen, and thrown into folds. In severe forms it may be dark red in color and covered here and there by adherent yellow membrane. In the severest forms the mucosa becomes necrotic.

If there is no obstruction to the urinary outflow, the pelvis is slightly distended with cloudy, purulent, and foul-smelling urine, sometimes containing necrotic epithelium. Hemorrhagic areas in the mucosa may be seen if calculi are present. When the urine is ammoniacal, granules of the phosphate of lime may be found embedded in the mucosa. When the latter is necrotic, the papilla simply may be covered with the necrotic membrane or they themselves may become involved

and slough off. The involvement of the kidney tissue occurs, as a rule, first in the medullary part of the organ. The path of the infection is shown by red stripes running from the pelvis to the capsule, along which rows of abscesses quickly arise and may appear on the surface of the kidney as thickly scattered elevated points. These abscesses increase in size and coalesce until the kidney is honeycombed with them.

There is usually stagnation of urine at this time and some dilatation of the kid-

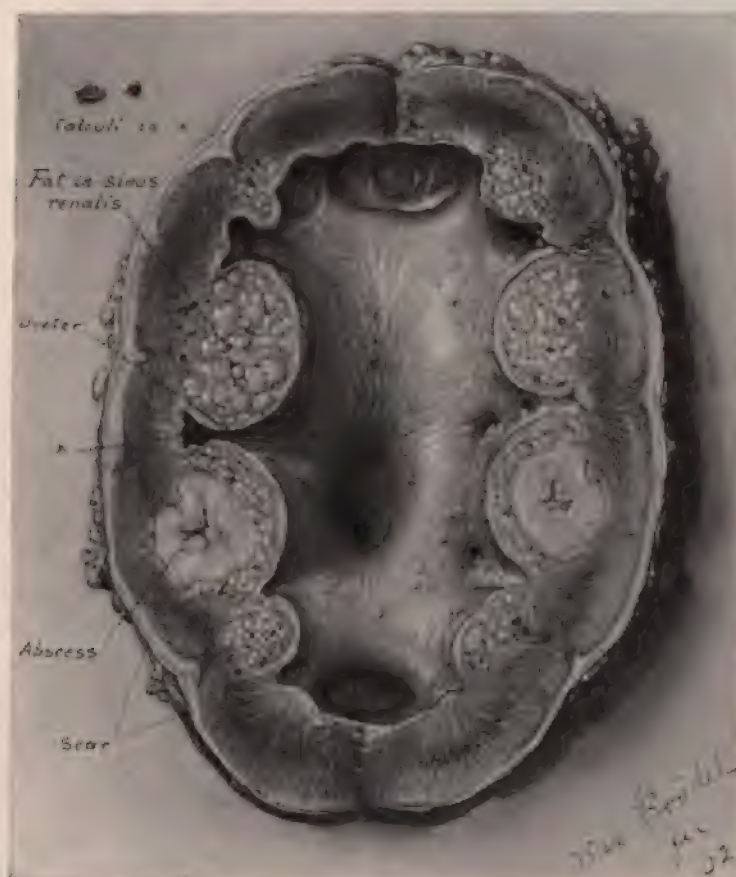


FIG. 844.—CALCULUS PYONEPHROSIS.

The distention of the kidney pelvis, the destruction of the kidney substance, and the adhesions of the surrounding fatty tissue are to be noted. (Natural size.)

ney pelvis secondary to the changes occurring in the mucosa of the pelvis which more or less completely block the ureter. The back pressure of the urine increases the tension within the kidney and favors the coalescence of abscess cavities with each other and with the kidney pelvis. In this way the organ may be converted into a large abscess sac with very little kidney tissue remaining.

There may be many variations in the course of the infection as it has been described. The process may be limited to the pelvis and never extend to the true

kidney substance. There are fewer changes in the kidney from pressure than in cases of hydronephrosis. When the evidences of pressure are marked, the lesion may have resulted from the infection of a previous hydronephrosis.

In case the pus from the kidney is entirely evacuated into the paranephric tissue, the organ may shrink and form a dense cicatrix, which has a cartilaginous or even a bony hardness. When the evacuation is but partial, an indurated and adherent fatty capsule may surround the eroded organ on all sides. In rare cases the abscess is not evacuated; the fluid of the pus is absorbed, and the remainder becomes thick and forms a yellow caseous substance packed into the irregular cavities within the kidney shell, the process thus resembling tuberculosis of the kidney.

Symptoms.—*Acute hematogenous suppuration* of the kidney, when it occurs in the course of a general bacteriemia, may be so rapidly fatal that there are no symptoms pointing directly to the kidneys, the indications of the kidney lesion being masked by the general symptoms.

Less violent forms are usually preceded by some general infection, such as typhoid, pneumonia, erysipelas, puerperal sepsis, etc. The patient suffers with a chill, dyspnea, cyanosis, high fever, and great prostration. The sensibilities may be clouded and there may be involuntary evacuation of the bowels. Sometimes there is violent pain in the loins, associated with oliguria or anuria. Blood and hyaline casts may be found in the urine. The kidney region may be sensitive to pressure, but no recognizable enlargement of the organ is present at first. Leukocytosis is present, varying in degree according to the severity of the infection and the resistance of the individual.

After suppuration in the kidney is established, the fever becomes remittent and is broken by chills. The patient enters a low typhoidal state and there may be symptoms of uremia.

The urine contains granular casts, pus, and albumin; the latter is excessive in proportion to the amount of pus. There may be no other alteration in the urine except a diminution in the total amount. A sudden increase in the amount of pus in the urine indicates the evacuation of an abscess into the kidney pelvis.

Death may occur from a combination of septic intoxication and uremia or from exhaustion. Or the disease may become chronic; a change to the chronic form being associated with an increased pyuria and an improvement in the general condition. Leukocytosis may disappear if the foci of suppuration in the kidney are draining freely through the ureter.

Ascending pyelonephritis is usually preceded by some lesion of the lower urinary organs; gonorrheal stricture is the most frequent; others are enlarged prostate, new-growths of the bladder, and new-growths or inflammatory lesions of the parametrium. Very often the attack is preceded by bacteriuria for a longer or shorter time. This may cause a patient no inconvenience except from the disgusting odor. The attention of the patient may be attracted also by the cloudiness of the urine. On examination the urine is acid and contains epithelial cells, leukocytes, and myriads of bacteria.

Cystitis may precede the kidney infection, or the bladder may remain comparatively healthy. Not infrequently the attack is precipitated by instrumentation of the urethra, bladder, or ureter. Sooner or later pyuria and pain along the ureter of the affected side occur. If the ureter is palpated through the vagina or the rectum, it may be found hard, thick, and tender. Dull pain and tenderness in the lumbar region or sharp stabbing pain radiating along the ureter may be present. The urine contains increasing amounts of pus.

Disturbance of the general health occurs, but is less pronounced when the urine remains acid. There is anorexia, coated tongue, and slight fever of a remittent or paroxysmal form.

If the urine becomes alkaline early, the general symptoms are more marked. Alkalinity is usually associated with severe cystitis. There may be diarrhea alternating with constipation. Anemia and emaciation occur. Leukocytosis is present if there is any accumulation of pus. There is clouding of the sensibilities and swelling of the feet and ankles; not infrequently an unpleasant odor of decomposing urine is observed on the breath and about the entire body.

The clinical picture may be modified. There may be severe renal colic associated with high fever and leukocytosis, the symptoms diminishing after a time coincidentally with a profuse discharge of pus in the urine. These attacks may be repeated until the patient is comfortable only when a considerable amount of pus is being passed in the urine. Attacks of sharp pain associated with diminished pyuria and increased pyrexia are due to obstruction. These symptoms are relieved when the pressure of the pent-up urine and pus overcomes the obstruction.

The affected kidney or kidneys gradually increase in size, the enlargement diminishing at times after the passage of a large quantity of pus.

In pyelonephritis which follows disease of the neighboring organs, attention will hardly be drawn to the kidney until vesical irritation, pyuria, or lumbar pain make their appearance. When suppuration occurs in an injured kidney, the symptoms of the trauma will be replaced by those of inflammation.

Diagnosis.—The severest form of *hematogenous pyelonephritis* is usually masked by the symptoms of a general bacteriemia. If in the course of, or shortly following, typhoid, pneumonia, or wound infection, there is a sudden chill followed by a rise of temperature, semi-consciousness, and stupor, a kidney lesion may be suspected. If oliguria or anuria is present, if casts and blood are found in the urine, and if there is any renal pain, the diagnosis is nearly certain.

In the less severe and the more chronic forms, local pain, tenderness, and slight enlargement will indicate a kidney lesion, and a careful examination of the urine and of the lower urinary organs for evidences of suppuration and obstruction will assist in the diagnosis. Occasionally pyuria for a long time may be the only local symptom of kidney suppuration.

In the course of a suppurative lesion *ascending* from the bladder to the kidney, there is some difficulty often in determining whether one or both kidneys are affected.

Moreover, it is possible for the symptoms of pyelonephritis to be masked by those of cystitis, or a cystitis may simulate a beginning pyelonephritis.

It is easy enough to determine an involvement of the kidney when that organ is enlarged and tender, but there is some difficulty in finding out whether the lesion is confined to the pelvis or has affected both the pelvis and the kidney substance. The presence of casts may be serviceable in making a distinction. If the enlargement of the kidney is intermittent and a diminution in size is followed by the discharge of a considerable amount of pus in the urine, a pyonephrosis is evident. There are certain cases, however, in which the diagnosis will necessarily depend upon a careful examination of the bladder, ureteral orifices, and urine.

Upon *cystoscopic examination*, in most cases of suppurative inflammation of the kidney, lesions will be seen at the site of the corresponding ureteral orifice. Sometimes, however, this sign is totally wanting. Garceau¹ reported a case of suppurating kidney in which the corresponding ureteral eminence and the bladder were not at all diseased. It is unwise to catheterize the ureters if the bladder is infected and the question of ureteral involvement is in doubt. Under such circumstances the separate urines may be collected by the Harris segregator, or the excretion may be collected directly from the ureteral orifice through a Kelly cystoscope. If the bladder is washed out thoroughly and the urine as it collects from the ureters is immediately examined, a fair idea of the kidney excretion may be obtained. If pus is coming from the kidney, it will be noticed in the urine at once; while if it comes from the bladder lesion, a little time must elapse after the irrigation before it appears to any extent in the urine.

The bladder itself need not show a lesion, although it usually does. This is either antecedent or subsequent to the renal involvement. If the bladder is clean and neither the state of the ureteral orifices nor the symptoms sufficiently indicate the exact position of the lesion, catheterization of the ureters will show the condition of each kidney.

The *constituents of the urine* and their amount may indicate to a certain extent the parts involved. Granular, blood, or pus casts indicate kidney involvement; a diminished excretion of urea has the same significance. Practically no exact differentiation can be made between the epithelium of the kidney and that of the bladder.

The amount of albumin is usually increased disproportionately to the amount of pus, when the kidney is involved. According to Küster, if the bladder alone is affected, the amount of albumin is rarely more than 0.1 per cent.; at most not above 0.15 per cent. In pyelonephritis it rises to two or three times that amount.

If the urine is alkaline, albuminous products will be caused by disintegration of the pus corpuscles or from the action of the bacteria upon the peptones. According to Schede, the quantitative test for albumin must be controlled by an estimation of the leukocytes in the urine; 50,000 to 70,000 pus cells per cubic millimeter

¹ Garceau, Edgar: "Vesical Appearances in Renal Suppuration," Boston Med. and Surg. Jour., 1903, cxlviii, No. 3, pp. 57-59.

is equivalent to 1 part of albumin per 1000 by the Esbach test. Red blood-corpuscles are more indicative of stone or tuberculosis than of pure pyelonephritis. Nucleo-albumin in large amount indicates pyelitis rather than nephritis.

The total excretion of urine has some significance. When an infection is confined to the kidney pelvis and in the early stages of pyelonephritis of the ascending form, polyuria is quite constant. In cases of intermittent obstruction to the ureteral outflow oliguria may alternate with polyuria. If there is permanent obstruction of the ureter, the urine may be normal in amount or there may be polyuria; the latter is due to excessive activity of the other kidney. The quantity of urine excreted by a kidney the seat of a suppurative process may be increased at first on account of congestion. When actual destruction of the parenchyma begins, there is a diminution or a cessation of the excretion from the affected area, although the remaining uninvolved parts of the organ may act in a compensatory way for a time.

Prognosis.—The prognosis of suppurative pyelonephritis is grave. In the severest forms death occurs in from twenty-four to seventy-two hours. Most patients perish in from two to three weeks. Küster reports one hundred and forty-two deaths in three hundred and twenty-eight cases of pyelonephritis associated with bacteriuria (43.29 per cent.). Favorable factors in the particular case are: Limitation of the disease to the kidney pelvis; a source of obstruction easy to overcome; a unilateral affection; youth and an otherwise healthy body.

Treatment.—In the *descending* or *hematogenous form of pyelonephritis* treatment at first must be directed toward the lesion to which the kidney infection is secondary. Any primary foci of infection which can be eradicated should receive immediate attention, while at the same time the patient is supported by such general measures as are indicated in bacteriemia and septicemia. Attention should then be given to the kidney, over which dry cups and applications of ice may be used. As soon as there is palpable enlargement of the organ and the evidences of suppuration therein are definitely established, operation may be considered. If the general condition of the patient permits, the kidney should be exposed in the loin, the pus should be evacuated through the ordinary nephrotomy incision and efficient drainage provided.

In a mild *ascending infection* where the disease is probably limited to the kidney pelvis there are two indications: First, to relieve any obstruction which may exist; and second, to increase the amount of urine and render it as bland as possible.

It may be evident from the first that a serious degree of obstruction is present. An immediate operation may be required if there is a stone blocking the ureter, a high ureteral stricture, or a violent ulcerative cystitis. In some cases dilatation of the urethra, permanent urethral catheterization, or repeated catheterization and irrigation of the bladder will suffice to prevent retention and place the lower urinary organs in the most favorable condition.

In pyelitis caused by ureteral stricture catheterization of the ureter and irrigation of the kidney pelvis with warm boric acid solution until the fluid returns clear may be curative. Following the irrigation with boric acid, silver nitrate 1 to 3

parts to 1000 may be tried. All local measures must be employed with the greatest gentleness and the most rigid asepsis.

The urinary antiseptics and diluents employed should depend upon the reaction of the urine. If the urine is acid, salol, grs. v to x, may be given every three hours with a full glass of water. In case the urine is alkaline, benzoic acid and urotropin (grs. v to x every three hours) should be administered. Aside from these measures, the patient should be put to bed and a skim milk diet should be prescribed. If there is pain in the lumbar region, dry cups followed by hot fomentations should be used. Hypodermic injections of morphin may be required. If uremia supervenes, hot packs with hypodermoclysis and rectal enemata of salt solution are indicated.

If the symptoms become progressively worse, so that retention of pus within the kidney pelvis or an extension of the suppurative process to the body of the organ is suspected, immediate surgical intervention is indicated. Unless this is done promptly, widespread destruction of the kidney may occur. If after exposing the kidney it appears certain that the suppuration is entirely confined to the pelvis, an incision into the posterior wall of the latter may suffice. The margins of the pelvic incision should be stitched to the borders of the wound and efficient drainage provided. If the process has extended to the medulla or the cortex of the kidney, a nephrotomy incision should be made along Brödel's white line and the pelvis and calyces exposed to thorough examination. All collections of pus should be evacuated and abundant drainage provided. No extensive search should be made at this time for an obstruction, and no attempt to treat one surgically should be made, unless it is very apparent and easy to remove, as, for example, in the case of some calculi.

In well-marked cases of pyonephrosis nephrectomy may be done at once if the kidney is hopelessly destroyed and the excretory activity of the other kidney is known to be good. Even in very advanced cases, however, if the function of the other kidney is a matter of doubt, primary nephrectomy is absolutely contraindicated. It is remarkable that apparently useless kidneys have been restored to function by nephrotomy, and that the removal of such an organ has led to the discovery that it was the only kidney or the better one the patient possessed.

There is a form of hydronephrosis complicated by pyelonephritis in which a moderately distended pelvis communicates with multiple dilated calyces; this is spoken of by Fenger as a "sacculated" kidney. He believes that the condition occurs in cases of hydronephrosis which have been infected early, and the inflammatory process has resulted in a thickening of the submucosa and a retraction or, at least, a resistance against dilatation of the tissues.

The best operative treatment for sacculated kidney is to perform nephrotomy and divide the partition walls so that there is free communication between all parts of the kidney sac. Hemorrhage is controlled by digital pressure, the cautery, sutures, and gauze tamponade. After drainage has reduced the inflammatory trouble and the obstruction to the ureter has been overcome, either by repeated

...ing from above or by a plastic operation, the two halves of the bisected
...y should be released from adhesions and united. In this way Fenger has
...ed such an organ to functional activity.

TUBERCULOSIS OF THE KIDNEY.

Frequency.—Walker¹ found seven hundred and eighty-four tuberculous subjects in 1369 autopsies. There were kidney lesions in sixty-one. In thirty-six cases of miliary tuberculosis the kidneys were affected every time. The rather high proportion of tuberculous cases at the Johns Hopkins Hospital, Walker believes is explained by the fact that a routine microscopic examination of all organs was made. The liver and the spleen were involved just about as often as the kidney. Morris records that there were seventy-four cases of renal tuberculosis observed in 3331 autopsies at the Middlesex Hospital, and in but ten of the seventy-four was the disease confined to the kidney.

Walker could not demonstrate a single case of primary tuberculosis of the kidney, although in six instances the process seems to have started in some part of the genito-urinary tract. As Morris remarks, however, "the multiple conditions found at death do not prove that the tuberculous disease was not for a time limited to one kidney, and that from this source the disease was disseminated to the other organs or parts." That primary tuberculosis of the kidney does occur is proved by the case (autopsy) recorded by Stewart and Kelly.²

Age and Sex.—The disease is uncommon in the young except as a part of general tuberculosis. The average age of patients suffering from renal tuberculosis is thirty-two and a half years.³ It occurs a little oftener in males than in females. Either kidney may be affected.



FIG. 845.—TUBERCULOUS KIDNEY. SPECIMEN IN THE KENSINGTON HOSPITAL, PHILADELPHIA.

¹ Walker, George: "Renal Tuberculosis," Johns Hopkins Hosp. Rep., 1904, xii, 455.

² Stewart, D. D., and Kelly, A. O. J.: "On the Occurrence of Primary Tuberculosis of the Kidney, with Special Reference to a Primary Miliary Form," Med. News, Aug. 14-21, 1897. p. 193.

³ Hunner, G. L.: "Tuberculosis of the Urinary System in Women; Report of Thirty-five Cases," Johns Hopkins Hosp. Bull., 1904, xv, No. 154, p. 8.

Pathology.—A tuberculous infection may reach the kidney through the blood (the usual route), by extension from surrounding organs, as tuberculous disease of the vertebra, and, it has been stated in the past, by an extension upward from the bladder. This form, or ascending infection from the bladder, is very rare, if it occurs at all. No such case has been observed by either of the authors. The conditions for its occurrence are more favorable in the male than in the female.

Predisposing causes are trauma of the kidney or diseases which lower its resistance. Among the latter may be mentioned kidney stone, acute nephritis, and any disease of the lower urinary tract which leads to a stasis or obstruction of the flow of urine.

When infection occurs by way of the blood, renal tuberculosis may appear in a miliary or in a caseous form. Miliary tuberculosis of the kidney as a part of a general miliary tuberculosis has no surgical interest. The caseous variety differs in its gross appearance as to whether the ureter is obstructed or not. According to Walker, when the ureter is patent, the kidney may not be enlarged. It is usually irregularly lobulated, some of the lobules being hard, others soft and fluctuating. Scattered throughout the cortex and medulla there are "nodular areas composed of grayish-white and yellowish-gray masses." These are prone to be collected at the poles. Later they coalesce and liquefy, forming cavities with irregular, ragged, grayish-red walls and grumous contents. Larger cavities are formed by the destruction of the intervening kidney tissue and the coalescence of smaller ones. The entire kidney may be converted into an abscess sac. Cysts the size of a filbert are sometimes observed in the renal substance. They are produced by the obstruction of an excretory tubule coming from a healthy part of the kidney parenchyma.

When the ureter is blocked (tuberculous disease of the ureter or tuberculous debris or blood-clot in the ureter), there may be a rapid destruction of the entire kidney by caseous degeneration without much enlargement, or there may be at first a moderate degree of hydronephrosis followed by liquefaction of the caseous material and the conversion of the kidney into a large abscess, occasionally three or four times the size of the normal organ. In the typical hydronephrotic form there is less invasion of the kidney substance, although it finally atrophies from pressure. A large fluctuating tumor is formed, containing turbid fluid, in which the tubercle bacillus may be demonstrated by injecting a guinea-pig. Tuberculous lesions in the pelvis and calyces are usually present.

The ascending form of renal tuberculosis is very rare in women. Vesical tuberculosis in the female sex is almost invariably secondary to renal tuberculosis. In men tuberculosis of the bladder may be secondary to tuberculous orchitis, epididymitis, and seminal vesiculitis. Tuberculous cystitis in men is usually secondary to a kidney lesion.

In the ascending form of renal tuberculosis, it is said, there is some obstructive lesion of the lower urinary organ leading to a stasis of urine. The lesions first become apparent in the pelvis and calyces. The disease extends finally to the kid-

entire organ may be converted into an abscess or a cheesy

process becomes tuberculous from the extension of a neighboring process, is directly invaded by an erosion of its capsule. The process may be infected through the lymphatics and the capsule remain intact. If the capsule is eroded, there is usually no change in the size of the kidney. The process is well advanced.

The process in the kidney may be complicated by a mixed infection.

The destructive process is intensified and suppuration occurs.

It may be associated with kidney calculus. Each may intensify the other. A calculus has often appeared to be a predisposing cause of tuberculosis, and tuberculous lesions undoubtedly may become calcified and lead to the formation of a calculus.

A tuberculous process may exist in one kidney for a long time without any involvement of the opposite organ; Walker believes that in the majority of cases the disease may elapse. The opposite kidney has been found tuberculous in 9 per cent. of cases and the seat of nephritis in 8 per cent. of cases at the time of operation.

Reports of renal tuberculosis found at autopsy indicate a much larger ratio of involvement of the second kidney. Both organs were involved in all but three out of forty-one cases collected by Walker. Some form of nephritis of the second kidney exists in 78 per cent. of the cases examined post-mortem, and is apparently due to the excretion of tuberculous toxins.

According to Gaultier (quoted by Walker), the ureter is involved in from 10 to 12 per cent. of cases of renal tuberculosis. Although bladder symptoms are customary, actual tuberculous involvement is not so frequent. A marked cystitis is quite common. The latter is caused by the irritation of the tuberculous products coming from the kidney. The mucosa surrounding the mouth of the ureter is especially involved on the affected side. According to Walker, "the bladder is implicated fairly early, and very few cases show a duration of more than eight months without tuberculous invasion of this viscus."

Symptoms.—Tuberculosis of the kidney may begin insidiously and give rise to few or no symptoms until the process is considerably advanced. Cases have been found at autopsy in which there had been no symptoms. The manifestations of the disease and the time of their first appearance depend upon the location of the process and the accidents to which it may be subjected. Thus, a tuberculous lesion near the renal calyces or pelvis would usually produce symptoms sooner than foci in the cortex, and a lesion early infected by pyogenic organisms would show itself much quicker than an uncomplicated one. There may be no symptoms until the disease has reached the calyces or pelvis.

The first symptom usually is an irritability of the bladder associated with polyuria. The patient complains of a frequent and intense desire to urinate and has pain after completing the act. Renal colic may be the first manifestation of tuberculosis, if a previously quiescent focus bursts into the kidney pelvis. If the

tuberculous process is so situated that it soon causes the erosion of a papillary blood-vessel, hemorrhage may be an early and a very alarming symptom.

Shortly after the onset of symptoms pyuria and hematuria appear. Neither may be more than microscopic, or the urine may be putrid with pus or scarlet with blood. Sometimes there may be granular and hyaline casts. Albumin at first is in direct proportion to the pus and blood; later there is an essential albuminuria, from either the affected kidney or its fellow. The urine in advanced cases contains kidney and pelvic epithelium. Occasionally there is renal tissue or connective tissue and elastic fibers and little clumps of meal-like detritus (White and Martin). Tubercle bacilli may antedate pyuria. The urine does not become alkaline unless mixed infection occurs. Then there may be considerable mucous sediment and the urine may be foul-smelling. Clear urine may alternate with pyuria if the bladder is clean, the affected side is obstructed, and the opposite kidney is healthy. If pus occurs in great quantities, there is probably a mixed infection, and staphylococci, colon bacilli, or streptococci will be found in the urine.

There may be a constant feeling of discomfort or uneasiness in the renal region, with tenderness on deep pressure; or there may occur from time to time attacks of renal colic. These attacks are produced by blockage of the ureter with masses of tuberculous detritus or blood-clot, or they may occur from inflammatory congestion.

At first there is no change in the abdominal wall. Later, particularly if the paranephritic tissues are involved, there may be rigidity. The kidney tumor varies from a slight enlargement to a tumor filling half the abdomen, the average size being one and a half times that of the normal kidney. At first the tumor is firm, but later it shows fluctuating areas, and finally becomes a soft fluctuating mass. When the left kidney is affected, the spleen is pushed forward and the renal enlargement is obscured. When the perirenal tissues are involved, the mass is much greater and more superficial.

There is usually a slight evening rise of temperature as the disease advances. Later it is more marked and varies in twenty-four hours from 4° to 5° F. If there is a secondary infection, it may rise to 105° F. Fever may occur only when the urine is clear, the rise of temperature being due to retention of pus within the kidney. Exhausting sweats, emaciation, and anemia fill out the clinical picture in advanced cases.

Diagnosis.—Tuberculosis of the kidney may be mistaken for renal calculus, pyelonephritis, tumors, and functional hematuria.

Significant symptoms of tuberculosis are persistent dysuria with an increased excretion of acid urine in the absence of a bladder or ureteral lesion. Continued pyuria, or occasional hematuria with acid urine, and irritability of the bladder, are highly suggestive. Kelly¹ reports Caspar as insisting that when there is con-

¹ Kelly, H. A.: "Some Surgical Notes on Tuberculosis of the Kidney," *Brit. Med. Jour.*, June 17, 1905, p. 1319.

tinuous acid pyuria and the urine obtained by catheterization does not yield a growth of organisms on the ordinary culture-media, the case should be suspected as one of tuberculosis.

Pain at the end of urination with a frequent intense desire to void urine may exist before there are any visible alterations in the bladder. Later there may be marked cystitis or an actual tuberculous disease of the bladder. The ureteral orifice of the affected side is edematous, congested, or positively inflamed, and the region of the ureter is the site of either inflammation or ulceration. Between the ureter and the trigone there are a number of clearly defined inflamed areas of mucous membrane with unchanged mucosa between them, which Meyer¹ compares to "footprints in freshly fallen snow." According to Schede, actual disease begins at the mouth of the ureter as grayish kernels visible in the mucosa; they grow larger, coalesce, and break down into an ulcer with a grayish base and ragged edges. The bladder is in a state of almost constant contraction, and its capacity may be diminished to 30 to 50 c.c. In advanced cases the bladder feels enlarged and thickened.

In renal calculus, dysuria is not so marked, the hemorrhage is more profuse upon exertion, and there is less failure in the general health. In all cases of suspected tuberculosis an x-ray picture should be made to exclude the possibility of stone.

Infection of the kidney (pyelonephritis) is more violent in its course; local kidney symptoms develop quickly and are pronounced, and there is less apt to be induration and thickening of the lower part of the ureter.

Tumors show less or no fever, no local inflammatory symptoms, no pyuria, more hematuria; the kidney enlarges rapidly and cachexia supervenes.

For a discussion of essential renal hemorrhage, which may suggest tuberculosis of the kidney, see page 815.

In renal tuberculosis there may be evidence of tuberculosis elsewhere in the body, either past or present. The indication of previous disease may exist in swellings or scars in the region of the submaxillary, cervical, axillary, and inguinal glands, or there may be lesions in the lungs, bladder, seminal vesicles, prostate gland, and epididymis.

The sediment of a considerable quantity of urine obtained from the bladder if it is healthy, or from the ureter of the diseased side if the bladder is involved, should be secured in an aseptic manner and injected into the peritoneal cavity of a guinea-pig. If the urine comes from a tuberculous kidney, the animal usually dies in from three to five weeks; if death does not occur, the animal should be killed at the end of six weeks and examined.

In the meantime a couple of smears from the urinary sediment should be stained each day and examined for tubercle bacilli. Walker allows the urine to settle in a conical glass for twelve hours. The slides are boiled for thirty minutes in caus-

¹ Meyer, Willy: "Early Diagnosis and Early Nephrectomy for Tuberculosis of the Kidney," *Med. News*, May 1, 1897.

tic soda and then washed for half an hour in order to render them absolutely free from fat, wiped dry, and two drops of the sediment are placed on each slide. The slides are placed ten inches above a Bunsen burner and dried. They are fixed in the flame and then placed in a 5 per cent. solution of hydrochloric acid in alcohol for five minutes to dissolve the urinary salts. After washing carefully in running water they are stained for ten minutes with carbol-fuchsin and decolorized with Gabbett's blue. If pus is present in small amounts only, the urine is centrifugalized in order to obtain the sediment. Care must be observed even in catheterized specimens lest the smegma bacillus be mistaken for the tubercle bacillus. In order to exclude the smegma bacillus, stain in the usual way with carbol-fuchsin, decolorize with 25 per cent. nitric acid, wash the slide for two minutes with 95 per cent. alcohol, and counter-stain with methylene-blue. In some cases it will be necessary to inoculate a guinea-pig in order to exclude the smegma bacillus. No method of staining is absolutely reliable. The guinea-pig test is the best means of making a positive diagnosis, especially in early cases.

In general it may be said that the tuberculin test as a means of diagnosis is not very reliable and it may even be harmful. Guiteras¹ believes that a positive reaction after an injection of tuberculin is a very strong evidence of an active tuberculous lesion. A negative result is not so valuable, for in a certain number of old encapsulated tubercles a positive reaction does not occur even though a considerable dose has been given. In using the tuberculin test the temperature should be taken every two hours for three days preceding the injection. The tuberculin must be carefully prepared and tuberculous foci elsewhere in the body must be excluded in drawing conclusions. This source of error cannot be eliminated in many cases. The ophthalmo-tuberculin test, Calmette's reaction, may be useful.

It is advisable in all cases to determine the exact conditions of the second kidney. If there is no vesical disease, both ureters may be catheterized. If the bladder is the seat of infection, catheterization of the presumably sound ureter should be avoided if possible. That there is danger from catheterization of the sound side is shown by Hunner,² who reports a case which resulted in the ultimate disease of the healthy kidney. He believes the practice unnecessary, and recommends either gathering the urine from the healthy ureter by simply holding the speculum under the ureteral orifice, or catheterizing the diseased side, washing out the bladder thoroughly, and then taking the urine which collects there in the next few minutes as representing the opposite side. Allowance is made for a few pus and epithelial cells from the bladder. If it becomes necessary to catheterize the sound size, it will be wise to follow the plan of Noble,³ who irrigates the bladder immediately preced-

¹ Guiteras, Ramon: "Diagnosis and Surgical Treatment of Tuberculosis of the Kidney," Detroit Med. Jour., 1903, iii, 1.

² Hunner, Guy L.: "Tuberculosis of the Urinary System in Women," Johns Hopkins Hosp. Bull., 1904, vol. xv, No. 154, p. 8.

³ Noble, Charles P.: "Tuberculosis of the Kidney," Surg., Gynec. and Obstet., 1907, iv, March, p. 264.

ing cystoscopic examination, and before inserting the ureteral catheter wipes the orifice of the ureter with a pledget of cotton and bichlorid solution 1 : 10,000. Or the ureters may be catheterized after distention of the bladder with boric acid solution through a catheterizing cystoscope.

Kelly warns that the opposite healthy kidney may be enlarged and compensating and must not be mistaken for the diseased organ. Such an error has been made, the healthy organ being extirpated instead of the diseased one.

Prognosis.—Renal tuberculosis may cause death within several months or life may be prolonged for a number of years. It shows no tendency to undergo spontaneous cure, and a subsidence of the disease is only secured in a few cases, after the kidney parenchyma has been entirely destroyed and the organ converted into a fibrous mass.

Treatment.—The only hope of a cure lies in an early nephrectomy. Time spent in climatic and other treatment is lost. Unless contraindicated by the general condition of the patient or by involvement of the second kidney, nephrectomy should be performed as soon as a diagnosis is made. If the second kidney is also tuberculous, nephrectomy would be ill advised. Under such circumstances, primary nephrotomy of the most diseased organ is best, followed by nephrectomy later if the organ is functionally useless or nearly so. In the case of an advanced or active tuberculous lesion of the lung nephrectomy cannot be performed with safety; nephrotomy and drainage may be substituted. Nephrotomy in a tuberculous kidney usually gives very unsatisfactory results and should rarely be employed; and then only to stop septic absorption or to permit a final determination of the functional capacity of the opposite kidney.

KIDNEY STONE; RENAL CALCULUS; NEPHROLITHIASIS.

Etiology.—Kidney stone as met with in surgical practice occurs most frequently in patients between the ages of thirty and fifty. Precipitates of uric acid and small calculi are rather frequently found in the kidney pelvis of infants and young children. Most of them are so small that they are washed out by the urine, but occasionally they give rise to symptoms and require treatment, and many cases of calculus coming to operation later in life are undoubtedly due to deposits beginning in childhood. Nephrolithiasis is more common in the male than in the female. The disease is more frequent in tropical countries, although its distribution varies widely in different parts of the globe.

There is probably no more hereditary predisposition to calculus than that which pertains to the uric acid diathesis. Cases have been reported, however, of kidney stone in several members of the same family, even though they lived widely apart and under different conditions of life.

There is no constant relation between the chemical composition of the drinking-water and the frequency of nephrolithiasis. The amount of water consumed by the individual is probably of more importance in this connection, an abun-

tic soda and then washed for half an hour in order to render them absolutely from fat, wiped dry, and two drops of the sediment are placed on each slide. Slides are placed ten inches above a Bunsen burner and dried. They are then placed in the flame and then placed in a 5 per cent. solution of hydrochloric acid for five minutes to dissolve the urinary salts. After washing carefully in water they are stained for ten minutes with carbol-fuchsin and decolorized with Gabbett's blue. If pus is present in small amounts only, the urine is decolorized in order to obtain the sediment. Care must be observed even in specimens lest the smegma bacillus be mistaken for the tubercle bacillus. In order to exclude the smegma bacillus, stain in the usual way with carbol-fuchsin, decolorize with 25 per cent. nitric acid, wash the slide for two minutes with 10 per cent. alcohol, and counter-stain with methylene-blue. In some cases it is necessary to inoculate a guinea-pig in order to exclude the tubercle bacillus. No method of staining is absolutely reliable. The guinea-pig test is the only method of making a positive diagnosis, especially in early cases.

In general it may be said that the tuberculin test as a means of diagnosis is very reliable and it may even be harmful. Guiteras' belief is that a positive reaction after an injection of tuberculin is a very strong evidence of tuberculous lesion. A negative result is not so valuable, for in a large number of encapsulated tubercles a positive reaction does not occur even when a large dose has been given. In using the tuberculin test the temperature of the urine every two hours for three days preceding the injection should be noted. In carefully prepared and tuberculous foci elsewhere in the body the tuberculin test drawing conclusions. This source of error cannot be avoided. The ophthalmo-tuberculin test, Calmette's reaction, is also of value.

It is advisable in all cases to determine the exact extent of the disease. If there is no vesical disease, both ureters may be catheterized. If the seat of infection, catheterization of the ureters should be avoided if possible. That there is danger from catheterization is shown by Hunner,² who reports a case which resulted in the healthy kidney. He believes the practice of catheterizing the ureter by gathering the urine from the healthy ureter by catheterizing the ureteral orifice, or catheterizing the diseased ureter, is dangerous. He advocates thoroughly, and then taking the urine which comes from the diseased side as representing the opposite side. Allowance should be made for the cells from the bladder. If it becomes necessary to catheterize both ureters, be wise to follow the plan of Noble,³ who irrigates the bladder by successive

¹ Guiteras, Ramon: "Diagnosis and Surgery of the Kidney," *Detroit Med. Jour.*, 1903, iii, 1.

² Hunner, Guy L.: "Tuberculosis of the Ureter," *Bull.*, 1904, vol. xv, No. 154, p. 8.

³ Noble, Charles P.: "Tuberculosis of the Ureter," *March*, p. 264.

dance acting as a prophylactic measure by diluting the urine and rendering precipitation of its salts less likely.

A very rich diet, composed largely of nitrogenous food, is conducive to kidney stone; and the same may be said of an insufficient diet, especially in the children of the poorer classes who are fed on substitutes for fresh milk.

Certain lesions associated with a rapid destruction of bone, as osteomalacia or multiple bone tumors, result in an excess of lime salts in the blood and the formation of calculi.

The uric acid diathesis favors the concretion of calculi by raising the amount of uric acid in the urine, thus increasing the degree of its precipitation.

People of sedentary habits are especially predisposed to kidney calculus.

Pathology.—*Kidney* calculi usually originate from a deposit of urinary salts upon an organic basis. This organic matter may be a ball of mucus, or a clump of necrotic and desquamated epithelium, or a blood-clot, or the eggs or the body parts of certain parasites, as the *distoma hematobium* or the *filaria sanguinis hominis*. Foreign bodies and agglutinations of bacteria appear to have formed the nucleus in some cases. Detached particles of a new-growth or of a tuberculous focus may act in the same way. In the

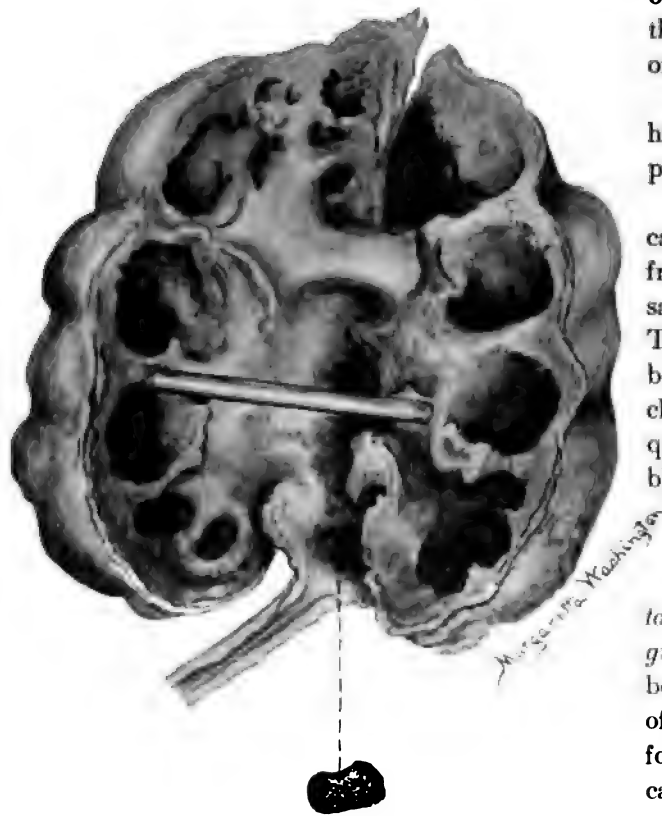


FIG. 846.—CALCULOUS PYONEPHROSIS.
Kidney destroyed; stone blocking the ureter.

great majority of cases, at the time the stone is removed no nucleus can be demonstrated.

After the nucleus has been formed, the stone increases in size by successive deposits and incrustations of urinary salts upon its surface. Changes in the composition of the urine during the life of a stone often result in the precipitation of a different salt than the one originally thrown down.

Kidney calculi may be composed of uric acid or urates, calcium oxalate or triple

Condition of the Opposite Kidney.—Inasmuch as kidney stone is largely due to constitutional causes, it is not surprising to find that the disease is often bilateral. Even if there is no stone in the second kidney, it may be the seat of other morbid changes. To have a calculus in one kidney and a perfectly healthy opposite organ is by no means invariable. The diathetic condition responsible for a unilateral nephrolithiasis frequently generates some form of nephritis in the opposite kidney. Some authors state that in nearly 50 per cent. of the cases, nephrolithiasis is bilateral, but Morris regards this as an exaggeration. He found the second kidney affected by calculus in not more than 10 per cent. of the cases. Infection of the calculous kidney usually produces alkalinity of the urine and this favors the formation of calculi in the opposite kidney.

Symptoms.—There are no pathognomonic symptoms of kidney calculus, positive diagnoses being made only by direct bimanual palpation of the stone through the abdominal wall, the passage of a wax-tipped ureteral bougie into the kidney pelvis, an x-ray picture, or an exploratory operation.

Aseptic Cases.—According to Musser,¹ the most constant symptom is pain in the affected organ. The pain is increased by movement, by jolting, and by pressure. It comes and goes, and is more commonly intermittent and paroxysmal. It is frequently constant and is localized over the kidney and posteriorly along the margin of the last rib of the affected side. That it may occur spontaneously is not so much significant of renal calculus as that it can be excited by pressure and movement. In Musser's experience it comes on during the day, especially the latter part of the day.

If the stone becomes displaced so that it blocks the ureter either at its pelvic orifice or along its course, renal colic occurs. This is a violent paroxysmal pain radiating from the lumbar region along the course of the ureter to the genitalia and the inner surface of the thighs. The suffering in some cases is extreme, so that the patient has all the appearance of severe shock or collapse. Nausea, retching, and vomiting are common. There is marked vesical tenesmus, and the patient straining even after the bladder is emptied voids a few drops of dark-colored or even bloody urine. The abdominal muscles on the affected side are rigid and the patient assumes various positions in an effort to find one which gives him ease. The attack varies in duration from one or two hours to as many days. It may end as suddenly as it began. Relief is experienced as soon as the obstruction is overcome by the stone passing into the bladder or being displaced from the mouth of the ureter into some other part of the kidney pelvis, or by the urine finding its way around the stone.

Renal colic is not characteristic of kidney calculus. It is no more than a symptom of great tension within the kidney, and may be occasioned by an acute inflammation or by a marked congestion of the kidney due to a twisting of the vessels at the hilus or by an obstruction of the ureter from blood-clots, inspissated pus, necrotic tissue, a kink, or the action of a valve.

¹ Musser, J. H.: "Renal Calculus," Phila. Med. Jour., April 16, 1898, p. 681.

The urine is usually of a high specific gravity, containing albumin and a small number of long and narrow hyaline casts. Hematuria is nearly constant; the amount of blood varies between a quantity sufficient to color the urine bright red (rare) and a few corpuscles only recognized by a microscopic examination (common) of the centrifugated specimen. The urine may at times be free from blood, but the daily study of a specimen will invariably show a persisting hematuria.

There may be a burning or cutting pain on urination; the lips of the external urinary meatus may be red and swollen and show a few crystals of urinary salts.

Shortly or some days after an attack of renal colic a small stone may be passed or it may be found in the bladder; at other times sand or gravel may be voided with the urine. Pyuria does not occur unless the kidney or some part of the urinary tract—the ureter, bladder, prostate, or urethra—is infected.

Persistent hematuria, high specific gravity of the urine, albuminuria, and hyaline casts are prominent symptoms of kidney calculus.

If the outflow of urine on the affected side is blocked and the other kidney is healthy, no abnormal constituents may be discovered upon urinalysis. In the event of an intermittent obstruction the pathologic elements may only occasionally be present in the urine. When one ureter is blocked by a stone, there may be a failure of excretion from the other kidney, so that the patient suffers from anuria. Sometimes this is nervous in origin and is entirely due to an irritation arising in the diseased kidney or ureter; it is then spoken of as reflex anuria. Many cases of so-called reflex anuria are really evidences of an obstruction of the ureter of the second kidney or, that there is no second kidney.

Septic Form.—When pyelonephritis is added to calculus of the kidney, fever, chills, sweats, and pyuria make their appearance. The kidney enlarges and becomes acutely tender. Uremic symptoms appear after the second kidney becomes infected.

Even a case of infected calculus may have few symptoms. Doran¹ reports a case of calculous pyonephrosis in which there was no pain and no fever. The kidney was considerably enlarged and cystic and contained pus and several calculi. There was no sign of inflammation in the tissues around the kidney. Doran thought that the stricture of the ureter which was present in the case had been caused by a previous ureteral calculus, and the subsequent ulceration and contraction of the ureter at the site of the stone. The symptoms in this case were mainly tenderness and nausea caused by the pressure of a corset, as in a movable kidney. The patient had noticed a swelling on the right side for a year. A corset made her feel nauseated and the right side ached a little. When undressed she was always comfortable. After swallowing food there was epigastric pain and nausea. No hematuria, no renal colic, and no fever or chills were ever observed. The abdominal walls were thin, the kidney was enlarged and could be pushed forward to midway between the

¹ Doran, Alban: "Painless Calculous Pyo-Nephrosis without Fever, Nephrectomy, Recovery," Brit. Med. Jour., Mar. 2, 1901, p. 509.

mammary and the median lines; the surface was bilobulated; fluctuation was obscure and there was no tenderness.

Doran calls attention to the experience of Bruce Clark in the post-mortem room at St. Bartholemew's Hospital. Twenty-four kidneys containing stones were discovered; eleven of these had well-marked symptoms during life, thirteen had not.

Diagnosis.—Illustrative of the difficulties experienced in the diagnosis of renal calculus, Morris notes forty-four cases in which surgical operation was undertaken for kidney stone but other conditions were found. Among these he mentions early tuberculosis, small abscess, suppurating cyst, solid renal or perirenal tumor or cyst, perinephritis due to sprain or trauma, ureteral stricture, ureteral valve, and displaced movable kidney. Intercostal neuralgia, lumbago, spinal caries, vesical tumors and calculus, chronic and subacute nephritis, and ureteritis have simulated renal calculus. The only positive diagnostic evidence of a stone in the kidney is furnished by palpation, the *x*-ray, a wax-tipped catheter, or an exploratory operation. A calculus in the kidney pelvis very rarely may be felt when the patient is thin, the stone is of good size, and there is no distention. If there are several stones, it is possible in exceptional cases to elicit crepitus. A stone may escape detection even by direct palpation of the kidney delivered through a lumbar incision or removed at autopsy.

Röntgen Rays.—According to Henry Pancoast, "the radiographic examination is the most uniformly accurate, and, therefore, the most valuable method at our command in the diagnosis of renal calculus, provided it is employed intelligently. The skiagraphic findings cannot of themselves, however, be accepted as absolute in every case, because of the possible existence of certain sources of error, which, though comparatively rare, must not be overlooked. Therefore this method of examination should always be used in conjunction with the other clinical methods of diagnosis and the symptoms which in the first place suggest the examination.

"The degree of error possible in any individual case may be more or less approximately determined by consideration of the following four definite factors concerned in the accuracy of the results of the radiographic examination for renal calculus: (1) The making of the radiograph; (2) the interpretation of the radiograph; (3) anatomic difficulties; (4) other conditions or objects, normal or pathologic, which may be capable of simulating the radiographic appearance of calculus.

"In connection with the first factor we may consider the skill and experience of the radiographer, the efficiency of his apparatus, and the preliminary preparation of the patient. As a rule, no radiograph should be accepted as of value for the diagnosis of renal calculus unless the intestinal tract of the patient has previously been thoroughly emptied of fecal matter by mild but efficient purgation, aided when possible by an enema. The stomach also should be empty, especially when the left kidney is suspected. The radiographer should be certain that there is no possibility of pills or foreign bodies of any kind being present in any part of the gastro-intestinal tract.

"An accurate interpretation of the radiograph requires equally as much skill

and experience as does the examination itself. The *x*-ray examination is essentially a consultation; therefore, the radiographer must possess a reasonable amount of knowledge of anatomy and surgery; and, likewise, the surgeon should possess a corresponding degree of skill and experience in interpreting skiagraphs of this kind.

"The anatomic difficulties likely to influence the accuracy of renal skiagraphs are an excessive amount of fat in the abdominal walls or omentum, thick muscular walls, tumors, and ascites. A reliable skiagraph of the kidney area should show at least the shadows of the psoas muscles, and, to be accurate, the shadows of the kidneys in addition. Whether the result of an examination be positive or negative as to stone, it should be repeated before a definite diagnosis is made. Two negatives made at the same visit will not answer; the two examinations should be made on different days.

"A radiograph is a shadow picture, and unfortunately there may be present somewhere between the *x*-ray tube and the plate other objects, usually abnormal, but which are capable of making a shadow similar to that of a calculus. This must be classed as an unavoidable source of error, though the degree of error may be more or less modified by the skill and experience of the radiographer. The most frequent examples of objects in the abdominal cavity which may produce misleading shadows are calcified lymph-glands, gas and fecal matter remaining in the intestinal tract due to careless preparation, pills or tablets not broken up or dissolved, fecal concretions, especially in the appendix, and collections of pus in the kidneys. In the pelvis one may be easily misled by the frequent occurrence of shadows due to phleboliths in the pelvic veins, intestinal contents, calcified lymph-glands, and sesamoids in the tendons arising from the spine of the ischium."

Kümmell¹ secured a perfect *x*-ray picture of a calculus in sixty-five out of eighty-four cases which came to operation. There were an equally large number of other kidney affections operated upon which simulated calculus, but failed to give a positive *x*-ray. To secure good results a carefully selected position of the patient, a good soft tube, and a well-adapted diaphragm are the principal factors. For a positive diagnosis it will be necessary to make several skiagraphs. In each plate the calculus must be shown to be in the same position. Kümmell regards this constancy of position as very important in differential diagnosis, and regards it as a characteristic sign of stone. The position of the stone on the *x*-ray plate is usually several centimeters from the spinal column and a little below the twelfth rib, corresponding to the anatomic position of the pelvis of the kidney. This is about the point where a horizontal line drawn through the body of the second lumbar vertebra meets the twelfth rib.

When renal calculus complicates pyonephrosis, there is a greater variation in the position, because such stones sink down in the dilated and altered pelvis and grow like coral rays into the enlarged calyces. The resulting dentate mass is more or less characteristic, and differentiates itself from intestinal contents and other acci-

¹ Kümmell, Hermann: "Modern Surgery of the Kidney," Surg., Gynec. and Obstet., Jan., 1907, p. 21.

dental confusing elements. Very stout persons are unfavorable subjects for the diagnosis of renal calculus by means of the x-ray. The difficulty may be overcome partly by compression of the abdominal wall at the time the picture is taken. Pure phosphatic stones, being soft, very often give no shadow.

Diagnosis of Renal Stone by Means of a Wax-tipped Bougie.—Kelly¹ uses a renal bougie, 2 mm. in diameter, with an olive point 3 by 2 mm. notched on two sides, the notch running lengthwise. The bougie is prepared by melting a mixture of olive oil and dental wax, two parts of wax to one of oil, dipping the end of the catheter in this, and allowing it to harden in the air. It then assumes a highly polished surface, exceedingly sensitive, and abraded by the slightest contact with any hard rough surface. In order to locate the exact position of the stone, whether in the ureter or the kidney, it is advisable to coat the entire length of the bougie. A stone low in the ureter produces a long continuous scratch extending along the catheter. The chief source of error in interpreting the marks on the wax are the scratches occasioned by contact with the cystoscope. (See Chapter XLIII, p. 734.)

Kelly reports eighteen cases of kidney stone in which the diagnosis was positively made by the wax-tipped catheter, and in which nephrolithotomy confirmed the diagnosis. In two cases stones were present and the waxed catheter failed to show them. He says the wax-tipped catheter may fail to find a renal calculus if the pelvis of the kidney is much dilated and if the stone is small, or if the calculi are lodged in cavities in the substance of the kidney, or if a large stone has fixed the pelvis of the kidney and the catheter pushes out the upper end of the ureter until it forms a little pocket.

In doubtful cases, when the symptoms are protracted or crippling, an exploratory incision is justifiable to settle the diagnosis of kidney calculus.

Treatment of Nephrolithiasis.—*Prophylactic.*—The prophylactic treatment of kidney stone consists in the adoption of measures to dilute the urine and to prevent the precipitation of the urinary salts. The reader is referred to standard text-books of medicine for the hygienic and dietetic treatment of the uric acid diathesis, oxaluria, and phosphaturia.

In a general way it may be said that an abundance of exercise, the avoidance of an excess of nitrogenous food, and the ingestion of large amounts of pure water are indicated. When the urine is very acid, the alkaline diuretics, such as potassium and lithium carbonate (gr. v to xx, three to six times daily), should be administered in sufficient quantity to render the urine neutral or faintly acid. If the urine is alkaline, antiseptics such as urotropin or salol (gr. x, t. i. d.), combined with benzoic acid (gr. x, t. i. d.), are useful. Piperazin (gr. x to xx, t. i. d.) is of special service in case the urine contains an excess of uric acid or urates, as is nitrohydrochloric acid (m ij to v, t. i. d.) in the case of oxalates. All of these drugs should be exhibited with large drafts of water. The reaction of the urine should be tested repeatedly

¹ Kelly, H. A.: "My Experience with the Renal Catheter as a Means of Detecting Renal and Ureteral Calculi," Amer. Jour. Urology, Oct., 1904.

and kept faintly acid by varying the dose of the alkaline diuretic. The dilution of the urinary excretion should be determined by noting the quantity passed in twenty-four hours and the amount of sediment.

The diet should be restricted in quantity and certain articles of food and drink should be avoided altogether. Liver, sweetbreads, kidneys, smoked or salt meats, green fruits, asparagus, tomatoes, rhubarb, strawberries, burgundy, port, sherry, and champagne are supposed to be especially harmful.

During an attack of renal colic the pain should be relieved by the hypodermic administration of morphin and atropin and the local application of heat.

Curative.—There are certain cases in which a stone may be suspected strongly and yet none can be positively demonstrated. Under such circumstances, if palliative measures are without result and the patient continues to suffer, it is advisable to do an exploratory nephrotomy. In many of these cases no stone will be found, but some other condition, as unsuspected tuberculous foci, small tumors, etc., which equally require surgical treatment. In numerous instances nothing has been found to explain the pain, but the symptoms have been relieved immediately. One of the authors has in mind a woman who had recurrent attacks of renal pain. Stone was suspected, but could not be proved to exist. Palliative treatment was ineffectual. At length nephrotomy was done and the kidney split from one end to the other in a futile search for stone; the patient was fully relieved of her symptoms. Numerous similar cases have been reported. They are probably instances of increased tension within the kidney from chronic nephritis. The nephrotomy results in the re-establishment of a circulatory equilibrium and the patient is relieved. Exploratory nephrotomy should never be performed until every other means to reach a positive diagnosis has been tried.

When the diagnosis of a kidney stone is positive, the best treatment in the majority of cases is an immediate operation. There are certain conditions which make active surgical treatment imperative and others which justify its postponement. Immediate operation is more of a necessity in case the kidney is infected, for then unless prompt relief is afforded the organ will be destroyed. When the stone is small and the kidney is aseptic, operation may be postponed to a suitable occasion, hoping in the case of a very small calculus that it will be passed spontaneously. If there is some reason for avoiding a surgical procedure, as old age, heart disease, etc., palliative treatment may be substituted. As a rule, however, even in the aseptic case with a small stone, the health of the patient will be best conserved by an immediate operation. One of us¹ reported a case of nephrectomy for pyonephrosis due to a kidney stone, in which the patient had suffered for three years. This type of case shows particularly the importance of an early diagnosis of calculus and the removal of the same by nephrotomy before the kidney has been destroyed by suppuration.

¹ Noble, Charles P.: "Report of a Case of Nephrectomy for Pyonephrosis Due to Impaction of a Stone in the Ureter," Amer. Jour. Obstet., 1900, vol. xli, No. 3, p. 308.

In the case of calculous anuria no time should be lost. The least affected kidney, as far as can be determined, should be immediately exposed and drained.

A stone may be removed by an incision into the kidney pelvis or parenchyma, depending upon its location and size. If the kidney is aseptic, the wound may be sutured and the operation completed without drainage. Such an ideal course cannot be pursued if there has been much dilatation of the kidney pelvis and there is any uncertainty about obstruction of the ureter. If the kidney has been distended, even though the parenchyma seems to be entirely atrophied, it is well to be satisfied with nephrotomy and drainage until it has been demonstrated that the organ is useless and that the second kidney is in good condition. In that event a secondary nephrectomy may be indicated. Likewise, if there is any doubt that the ureter is patulous, it is better to drain the kidney pelvis through the nephrotomy incision. If there is no obstruction, the fistula will almost surely close spontaneously. Except in emergency cases, the functional activity of each kidney should be determined before operation, so that primary nephrectomy may be performed when indicated.

When the kidney is infected, the operation of nephrolithotomy should be followed by ample drainage. Nephrectomy is never advisable primarily on account of the frequency of bilateral nephrolithiasis, unless the diseased kidney is hopelessly destroyed and the opposite organ is known to be free from calculi and functionally sufficient. It is much better to do nephrolithotomy (bilateral, if indicated) at first, and to follow this, if occasion requires, with nephrectomy.

For details of the operation of nephrolithotomy and nephrectomy see pages 834 and 836.

INFLAMMATION OF THE PARANEPHRIC TISSUES.

By paranephritis (Küster), perinephritis (Rayer), or epinephritis (Israel) is understood an inflammatory affection of the fatty capsule of the kidney. There are three forms: the fibrosclerotic, the lipomatous, and the suppurative or phlegmonous.

Fibrosclerotic.—In the fibrosclerotic form there is a transformation of the fatty capsule into a thick, hard, sometimes cartilage-like tissue, closely fused with the fibrous capsule of the kidney and robbing that organ of its normal mobility. This condition does not often present itself as a clinical entity, but it is found in connection with pyelonephritis, pyonephrosis, and nephrolithiasis. It presents an insuperable obstacle at times to the ordinary form of nephrectomy. The kidney with its encasement of fibrosclerotic tissue cannot be freed from surrounding structures without great danger to the important neighboring viscera or to the great blood-vessels. The diaphragm, the pleura, the vena cava, and the colon may be in danger. If nephrectomy is indicated in fibrosclerotic paranephritis, the subcapsular operation should be selected. (See page 836.) The fibrosclerotic tissue may produce considerable enlargement of the kidney. With this increase of size there is usually some pain and tenderness.

and kept faintly acid by varying the dose of the alkali. The hypertrophy of the urinary excretion should be determined by noting the amount of it, being collected in four hours and the amount of sediment.

The diet should be restricted in quantity and quality. Fatty foods, especially those of the fatty capsule, should be avoided altogether. Liver, sweetbread, green fruits, asparagus, tomatoes, rhubarb, strawberries, and champagne are supposed to be especially harmful in cases of calculi, nephrolithiasis, and during an attack of renal colic the pain should be relieved by the administration of morphin and atropin and the patient should be kept at rest.

Curative.—There are certain cases in which the pain is due to the fatty capsule occupying the place of the kidney, and yet none can be positively demonstrated.

Paranephrotomy is a form of paranephrotomy, and the patient should be kept at rest and yet none can be positively demonstrated.

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¹ Noble, Charles P.: "Remarks on the Treatment of a Stone in the Ureter." *Am. J. Surg.*, 1900, 1: 100.

of a Stone in the Ureter." *Am. J. Surg.*, 1900, 1: 100.

Lipomatous.—In the lipomatous form there is a great hypertrophy of the fatty capsule, which occasionally grows to the dimensions of a tumor. The hyperplasia affects either the entire capsule of the kidney or a part of it, being confined to certain areas, particularly the hilus or both poles. Localized forms give the impression of a tumor formation more than the others. The lipomatous tissue may also surround the ureter. Such an irritation-hyperplasia of the fatty capsule is caused by chronic inflammatory kidney processes, especially nephrolithiasis, and is often associated with atrophy of the parenchyma and sclerosis of the interstitial substance of the kidney. The atrophied kidney forms a nucleus for the fatty mass which surrounds it and penetrates it from the hilus, the fat occupying the place of the destroyed parenchyma.

Phlegmonous.—The suppurative or phlegmonous form of paranephritis may arise either in the capsule or it may extend to the capsule from contiguous parts. Phlegmons arising in the capsule may be due to perforating wounds with infection from the surface or from the intestines, or to the penetration of the capsule by foreign bodies entering from the bowel, as needles, fish-bones, etc. Blows, sprains, or falls may produce a phlegmon, presumably by the formation of a hematoma which is subsequently infected by bacteria transported in the blood from some other part of the body. Or these injuries may be associated with a slight cortical lesion of the kidney through which micro-organisms and urine may escape. Metastatic phlegmonous inflammation of this area may occur in the course of measles, variola, typhoid fever, etc.

Phlegmonous paranephritis is usually secondary to a disease of the neighboring organs or tissues. The kidney is the most frequent source of infection. Other sources are found in the inflammatory diseases of the urinary passages and of the retroperitoneal fatty tissue (following parametritis, prostatitis, and appendicitis). The suppurative process may invade the paranephric tissue by a direct erosion of the fibrous capsule of the kidney, or the infection may be conveyed through the lymphatic channels, there being no involvement of the kidney cortex. Infection may be carried also by the lymphatics from the lower ureter without any involvement of the kidney.

Israel says that since it is more widely known that nephritis may exist without albuminuria, fewer cases of phlegmonous paranephritis of unexplained origin are reported. While Küster in two hundred and thirty cases found sixty-seven, *i. e.*, 29.1 per cent., of doubtful origin, Israel had but three in his own forty-three observations (6.9 per cent.) in which he could find no cause. In Israel's forty-three cases, thirty-four arose from disease of the kidney, six from gonorrheal affections of the urinary passages, three from unknown causes.

Pathologic Anatomy.—In the great majority of cases the abscess points toward the loin and forms a visible and easily palpable tumor in this region. There are two points at which the pus tends to break through the lumbar fascia and muscles. The first of these is Petit's triangle, bounded by the crest of the ilium, the anterior border of the latissimus dorsi, and the posterior border of the external oblique. The

second is just below the twelfth rib, at the outer border of the erector spinæ. Abscesses appearing at this point penetrate the latissimus dorsi. Occasionally, however, instead of breaking through, they pass down the anterior surface of the muscle to Petit's triangle.

An abscess may also gain access to the thorax, traveling along the quadratus lumborum through the slit which the external arcuate ligament of the diaphragm forms, or along the sheath of the psoas muscle. In this way pus may gain entrance to the pleura or to the lung itself. An empyema or an abscess of the lung may result. The pus may remain within the diaphragm, forming an endophrenic collection, or it may travel downward back of the peritoneum along the ureters to the pelvis, or along the sheath of the iliopsoas muscles to Poupart's ligament. The abscess may find its way through the great sacrosclatic foramen to the gluteal region. It may break into the ureter, the bladder, the male urethra, the rectum, or the scrotum. In two hundred and thirty cases of paranephritis there were thirty-four abscesses which evacuated themselves into neighboring or far-distant organs—eighteen into the pleura, eleven into the bowel, two into the peritoneal cavity, two into the bladder and vagina, and one into the bladder alone.

Symptoms.—The lipomatous and the fibrosclerotic forms of paranephritis may have few symptoms in themselves and may escape the observation of a physician. Occasionally, however, there is a feeling of dull pressure in the affected area, and there may be stiffness of the back, an inclination of the body to the affected side, and some flexion and abduction of the thigh.

In the suppurative cases the symptoms arising from the paranephritic process may be masked by those of a preceding and associated kidney stone, pyelonephritis, pyonephrosis, etc. The typical symptoms of a paranephritis are seen in those cases in which the fatty capsule is the part principally affected and there is no pronounced kidney disease.

The disease may develop slowly and insidiously or very suddenly and without any warning. The early symptoms are pain, chills, and sweats. Usually this is followed by more or less fever, although there are cases in which pyrexia does not occur for a long time. The fever is usually remittent with evening exacerbations. Anorexia, nausea, vomiting, and emaciation occur. The patient presents a wasted, anemic appearance, a condition spoken of by the older writers as "phthisis renalis." If the paranephritis follows urinary extravasation into the fatty capsule and is gangrenous, there may be a profound septic condition. In connection with these more or less general symptoms of deep-seated suppuration, there are particular symptoms which draw attention specifically to the loin.

The pain is more or less constant in the lumbar region. It may be a feeling of dull uneasiness or an actual ache, or darting or pricking in character and paroxysmal, shooting into the axilla, breast, hypogastrium, thigh, and external genitalia. The pain is increased by bodily motion and deep inspiration, so that there is usually limitation of the respiratory movements and the patient inclines the body toward the affected side. The lumbar and abdominal muscles on the affected side are

occur during the period when tuberculosis is especially common. Sixty-one of Israel's sixty-eight cases occurred between fifty and eighty years; thirty-nine of Morris's one hundred and forty-eight cases (collected) occurred under the age of five.

KIDNEY TUMORS.

The tumors which affect the kidney and the kidney region are indicated by the following tables:

		<i>Solid.</i>	
Kidney.....	Benign.....	{	angioma lymphangioma osteoma enchondroma fibroma adenoma lipoma lipofibroma lipomyxoma carcinoma
	Malignant..	{	sarcoma..... mixed tumors.....
		{	round-cell spindle-cell mixed-cell perithelioma endothelioma embryonic adenosarcoma teratoma
Pelvis and Ureter..	Benign.....	{	hypernephroma papilloma myxoma
	Malignant..	{	papillary carcinoma squamous epithelioma angiosarcoma lymphatic endothelioma rhabdomyoma
Suprarenal glands....	Malignant..	{	hypernephroma carcinoma
Pararenal.....	Benign.....	{	lipoma fibroma myxoma
	Malignant..	{	hypernephroma sarcoma mixed tumors
		<i>Cystic.</i>	
Kidney.....	Benign.....	{	simple cysts polycystic disease benign adenocystoma echinococcus cysts
	Malignant....	{	malignant adenocystoma
Pararenal.....	Benign.....	{	blood cysts—trauma epithelial cysts from snared-off portions of kidney pelvis
		{	lymph cysts Wolffian body cysts dermoid cysts

Solid Tumors of the Kidney; Benign.—*Fibroma*.—Pure fibromata are very rare. Schede asserts that there is none on record.

Adenoma.—Adenoma is found oftenest in chronically inflamed and contracted kidneys and may reach a considerable size. There is a papillary form which sometimes becomes malignant.

Lipoma.—A pure lipoma is very rare. Lipomatous tumors are usually mixed tumors and contain myxomatous fibers and smooth muscle cells. They frequently become sarcomatous.

The other benign tumors of the kidney are of scientific interest only, as they never reach a large size or produce symptoms.

Fibroma, lipoma, and adenoma, if pure, usually give rise to few symptoms. After they are large enough to produce a recognizable tumor, the patient may complain of some weight or pressure in the renal region. When they attain such a size, they should be removed from the kidney by resection, if that is possible; otherwise, nephrectomy is indicated.

Malignant Tumors of the Kidney.—*Carcinoma.*—Carcinoma is one of the less frequent tumors of the kidney. There are three forms: (a) papillary; (b) nodular, circumscribed or adenomatous; (c) infiltrating.

The papillary is an advanced stage of a malignant adenocystoma, or it begins as a papillary tumor in the pelvis of the kidney. The nodular or the adenomatous cancer begins in the cortex; it may be the offspring of a simple adenoma. It exhibits an alveolar arrangement. The infiltrating cancer starts in the neighborhood of the pelvis and grows toward the cortex. It is cancerous from the onset and shows little alveolar structure. It may destroy the kidney without producing any increase in size or alteration of form. Hematuria may be absent in the nodular form. There is very much that is obscure in the histogenesis of renal carcinoma.

Sarcoma.—Sarcomata may arise from the connective tissue of the kidney substance or from the submucous connective tissue of the calyces and the kidney pelvis. Histologically they may be round-, spindle-, or mixed-cell, and they may be classed as simple angiosarcoma, vascular endothelioma, lymphatic endothelioma, and perivascular sarcoma or perithelioma. Most of the endothelial and the perithelial forms that have been described are really hypernephromas. The sarcomatous tissue may undergo myxomatous change, resulting in a myxosarcoma. Sarcomata containing bone, muscle, fat, and epithelium belong to the embryonal or mixed tumors.

Mixed Tumors.—*Embryonic Adenosarcoma.*—These tumors occur most often in childhood and infancy. They are composed of a mixture of glandular and of embryonal connective tissue. At times also they contain smooth and striated muscle cells. They have been named carcinoma, sarcoma, sarcomatous carcinoma, adenosarcoma, adenochondrosarcoma, myosarcoma, and rhabdomyosarcoma, according to the tissues which they contain. The tumors are very rapid in growth, enlarging in three or four months from the size of a fist to a tumor filling the abdomen. They may destroy or only partially invade the kidney.¹

Metastasis occurs by way of the blood-vessels to the liver, the lungs, the retroperitoneal glands, the second kidney, the intestines, and the pancreas. They very often cause a localized peritonitis and become adherent to the abdominal organs. Ascites may be present. The average weight is from five to fifteen pounds, but in

¹ Holt, L. Emmet: "The Diseases of Infancy and Childhood," 1905

one case the tumor weighed thirty-six pounds. The presence of a tumor is usually the first symptom. In nineteen out of fifty cases occurring in children, hematuria was noted before the tumor appeared. The only treatment is operation; this should be performed as soon as the condition is diagnosed.

The prognosis of these cases has been almost uniformly bad. The only hope lies in an early operation. Most cases are ultimately fatal, but cures have been reported.

The proper treatment is immediate nephrectomy. Bean¹ gives the percentage of permanent cure at 5 or 6 per cent. The disease is always fatal if let alone. From observations of his own and an examination of the literature, Le Conte² concludes, in relation to the treatment of these tumors, that with modern methods the immediate mortality should be reduced to 15 per cent. or even lower. Operation certainly prolongs life. The percentage of cases which will go three years or more without a sign of recurrence (the so-called cures) will be very greatly increased, if the physician can make an early diagnosis and secure an immediate operation. Even when the ultimate result is fatal, an operation relieves the suffering of the patient and makes death less painful.

Hypernephroma.—This is the most frequent malignant tumor of the kidney. Israel had fifteen, possibly seventeen cases, in forty-three malignant tumors of the kidney.

Hypernephroma is defined by Ellis³ as a tumor arising from adrenal tissue, whether in the suprarenal gland or in aberrant particles known as renal rests. Primary hypernephroma involves the kidney in 96 per cent. of reported cases; it may, however, occur in widely different situations. The possibility of hypernephroma occurring elsewhere than in the kidney or the adrenals is apparent from a study of the development of these glands. The adrenals and the sexual organs are so intimately related in their development that portions of the first may easily be displaced into the neighborhood of the second. Ellis quotes Radasch as saying that adrenal rests have been found in the kidney, the liver, the perirenal tissues, the solar and renal plexuses, the mesentery, the region of the internal abdominal ring, the inguinal canal, the spermatic cord, the epididymis and testicle, the broad ligament, and the fundus of the uterus.

Hypernephromas of the kidney are usually single. According to Ellis, whom we quote freely, the frankly malignant tumors vary in size from a pea to a child's head. The small ones are almost invariably confined to the renal cortex. Large tumors project from the surface of the kidney and extend inward, destroying the renal structure until they reach the pelvis, which may be obliterated by pressure, but is seldom actually penetrated. "The external surface of the tumor is lobulated. The color is usually grayish-red or yellow, the latter predominating; but often there

¹ Bean, J. W.: "Two Rare Forms of Tumor of the Kidney," N. W. Med., 1903, vol. I, No. 1, pp. 11-16.

² LeConte, Robert G.: "Two Cases of Nephrectomy for Sarcoma of the Kidney in Children with Operative Recoveries," Therapeutic Gazette, 1902, xviii, p. 577.

³ Ellis, E. G., with W. W. Keen and G. E. Pfahler: "On Hypernephroma," Amer. Med., 1904, vol. viii, No. 25, p. 1039.

are brown or bluish or even black areas through the presence in the tumor of small or massive hemorrhages. The tumor may be firm, but in many of the larger growths the projecting masses are softened, in some instances being almost cyst-like in consistency. Incision of the tumor reveals surfaces corresponding closely to the external appearance in color and in lobulation. Masses within alveoli formed by the fibrous stroma may be so soft as to project and even detach themselves from the surrounding tissue. The tumor is generally sharply outlined from any remaining renal structure by a complete band of firm fibrous structure (Fig. 848). Hemorrhages into the tumor are exceedingly common, and areas of softening due to degenerative changes are also frequently present."

All hypernephromas may be regarded as potentially malignant. Apparently benign hypernephromas are capable of giving rise to metastases larger than the primary growth. Metastases are most frequently found in the lungs, liver, and bones, although almost any tissue may be invaded.

Symptoms.—There are three chief symptoms of malignant tumors of the kidney: Hematuria, pain, and the solid growth itself. Cachexia and metastases appear in the later stages. The presence of a renal tumor is the only diagnostic certainty. In many cases its value as a diagnostic symptom is lessened, for when the growth is found, the case is inoperable; nevertheless, enlargement of the kidney is sometimes the only early evidence of the disease.

Hematuria is the most common initial symptom. It occurs with or without renal colic, appearing in more than 70 per cent. of Israel's cases without any warning in a previously healthy patient. In the other 30 per cent. of cases there were preliminary indications, such as a feeling of pressure in the kidney region, disturbance of the general health, anorexia, emaciation, a feeling of weakness, perspiration or indigestion, preceding the onset of hematuria.

Acute pain in both kidney regions, associated with a slight elevation of temperature and albuminuria, were the earlier symptoms in one instance recorded by Israel. As a rule, cachexia does not appear until the disease is far advanced (except in the rapid growing tumors of children), and fever does not often occur (five times in Israel's cases).

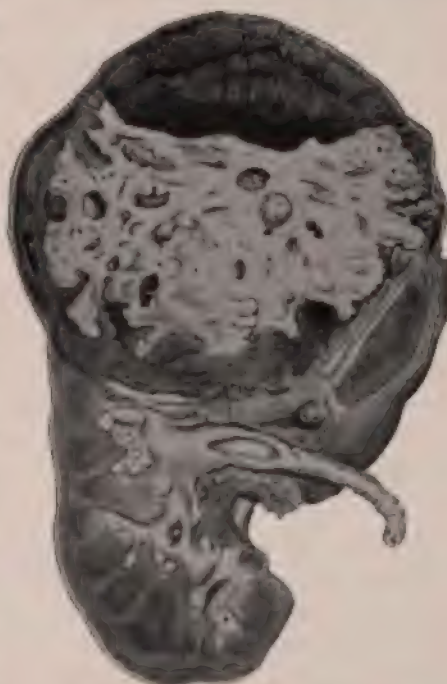


FIG. 848.—HYPERNEPHROMA OF KIDNEY.

Hematuria occurred in 92.1 per cent. of Israel's series and was the first symptom in 70 per cent. It may appear early in the life of the tumor, when the growth is no larger than a cherry, as happened in three cases. The value of hematuria as an early symptom and the failure to appreciate its significance is shown by four of Israel's cases, in which hematuria had been observed for eleven and a half, ten, eight, and six years, before the operation. In half of the cases the renal origin of the hemorrhage was indicated by colic or by a disagreeable sense of pressure in the loins—on the particular side in 45.6 per cent. Hemorrhage is to some extent independent of activity or repose. Although riding over a rough road increases it and a fall on the buttocks or the lifting of a heavy weight are responsible at times for its onset, hematuria is usually intermittent and may come on without apparent cause while the patient is asleep.

The *urine* may have the color of fresh blood. It usually varies in appearance from almost pure blood to a straw-colored serum. Grossly the urine may be clear and contain coagula. Worm-like clots 10 cm. long are quite significant of coagulation within the ureter. Shorter clots than this may be formed in the urethra.

Israel describes worm-like bodies in the urine, which he believes are almost pathognomonic of a malignant tumor. They usually occur in faintly bloody or clear urine, and are reddish, faint yellow, or white in color, occasionally somewhat transparent. They are about the size of maggots or even larger, up to 2 cm. in length and from 2 to 2.5 mm. in breadth. Microscopically they consist of a fibrinous ground substance, in which red blood-cells, shadow corpuscles, leukocytes, fat droplets, and swollen epithelium are embedded. They are formed after the manner of a stalactite from tumors which project into the kidney pelvis.

The urine may not look bloody, and yet red blood-cells are found on centrifugation. The urine occasionally appeared clear in forty-six of Israel's series, but in 80 per cent. of them the microscope showed red blood-cells and shadow corpuscles. This ratio he considers too low, for cases are included which were treated at a time when centrifugation was not customary. There were but two cases in his entire experience in which no abnormal constituents were found in the urine. A few leukocytes, large clumps of fat droplets, or large fatty degenerated cells were commonly present. Rarely there were casts and albumin in varying amount. Blood casts were found in but two cases, and both times they came from the second kidney. Polyuria was usual. Sometimes particles or shreds of the tumor were passed in the urine.

Pain may be the first indication of a kidney tumor. It varies from renal colic to a feeling of dull distress in the kidney region, accentuated by the pressure of the clothing or by unusual activity. The pain may be continuous or recurrent. It is felt in the loins or in the buttocks radiating into the hips. Neuralgic pains are observed occasionally along the distribution of the ilio-hypogastric and the ilio-inguinal nerves. In about 60 per cent. of Israel's cases there was pain which indicated the affected side.

Edema of the legs from pressure of the tumor on the iliac veins or the inferior

vena cava may occur. There may be intestinal disturbance or symptoms resembling those of chronic gastric catarrh. The heart may be affected. There may be hypertrophy of the left ventricle, just as there is in contracted kidney. A blowing murmur coincident with the systole of the heart may be heard and felt over the tumor.

Varicocele of the affected side is said to be one of the objective indications of a kidney tumor. Israel never observed it in small tumors and in large ones it was frequently absent.

Unless the tumor is large enough to interfere with the movements of the diaphragm, dyspnea is usually indicative of a pulmonary metastasis.

Palpation of a kidney the seat of a tumor may reveal a nodule projecting from the surface, a smooth symmetric enlargement of the organ, or a lower pole that is palpable with unusual ease; the latter phenomenon being due to a tumor of the upper half of the kidney which displaces the lower pole downward. Tumors are more easily palpable when they occur at the lower pole on the anterior surface or on the convex border. Palpation is much less difficult if the kidney is abnormally movable and can be freely pushed about.

The best position for the patient during palpation of the kidney is on the healthy side half-way between a dorsal and a lateral posture, so that the frontal plane of the body forms an angle of 45 to 50 degrees with the surface of the table. The spine should not be bent forward or backward, for this either puts the abdominal muscles on the stretch or narrows the ileocostal space. A correct position will be furthered by turning the pelvis a little toward the table after the half-lateral position is taken. When the position is correct, there will appear under the ribs of the diseased side a slight sinking in and the belly wall in its neighborhood will be relaxed. To estimate a symmetric increase in the size of the kidney a dorsal position is the most satisfactory.

The tumor was palpable in sixty-two of Israel's sixty-eight cases. In forty-one cases unevenness of the surface of the kidney and knobby prominences were recognized. Küster reports that of three hundred and seventy-nine cases of kidney tumor in adults, the condition was palpable in but two hundred and thirty.

Diagnosis.—Malignant tumor of the kidney in its early stages must be differentiated from tuberculosis and nephrolithiasis. Carcinoma of the colon and pancreatic cyst may bear some resemblance. A skiagraphic examination of the diseased organ and the injection of guinea-pigs with urine from the affected side will often be required to exclude kidney stone and tuberculosis. In doubtful cases an early exploratory incision is urgently demanded.

Prognosis.—The prognosis of malignant tumors of the kidney is bad, because they are not diagnosed early enough. Although they are comparatively slow in growth and may extend over a period of years (ten or fifteen), the ultimate result is usually fatal. Death, as a rule, occurs from extensions and metastases; sometimes from renal insufficiency and hematuria.

Treatment.—Most cases are diagnosed too late for radical treatment. When the growth is discovered early, immediate nephrectomy is indicated. If there are

evidences either of direct extension of the tumor to the surrounding structures or of metastases, operation is hopeless.

Extension to surrounding structures is indicated by a fixation of the kidney. Extension to the renal vein can only be diagnosed after the kidney is exposed at operation. The presence of varicocele in the case of a tumor of the left kidney speaks neither for nor against the involvement of the renal vein. Thrombotic tumor masses in the vena cava may be productive of no symptoms; nevertheless, a suspicion of this condition is well-founded if a thrombophlebitis of the femoral vein, or a dilatation and engorgement of the veins of the abdominal wall, scrotum, and lower extremities, make their appearance.

The bones especially deserve attention when evidences of metastases are sought. Not only enlargements, but areas of tenderness and a feeling of weakness in them, may be indicative of a secondary growth.

It is of less importance to determine the condition of the opposite kidney than in the case of nephrectomy for other lesions, because nephrectomy is the only hope for a malignant tumor and a bilateral affection is unlikely. Nevertheless, as a matter of prognosis, the excretory functions of the two kidneys should be estimated as accurately as possible.

In the forty-three cases of Israel there were eight operative deaths, five of them directly traceable to cardiac degeneration. The author calls attention particularly to this danger in nephrectomy for malignant tumor. Of twenty-nine cases which were operated on more than three years before his report, there were seven which died either at the time of operation or from some intercurrent disease. Of the remaining twenty-two, fourteen had recurrences and eight have remained healthy for fourteen, twelve, ten, eight, six, five, five, and three years respectively.

As in all other forms of malignant tumor, the keynote to successful surgical treatment is early diagnosis and early operation. (See treatment of embryonal or mixed tumors, p. 806, and nephrectomy, p. 836.)

TUMORS OF THE RENAL PELVIS.

Malignant Papilloma.—The most common tumor of the renal pelvis is malignant papilloma (Fig. 849). Israel saw two in his series of sixty-eight malignant tumors of the kidney. As Kelly¹ has noted, there is usually a multiplicity of lesions in malignant papilloma of the renal pelvis. Thus, among the cases collected by him, in two the kidney and the ureter, in one the kidney and the bladder, in one the kidney, the ureter, and the bladder, and in one both kidneys and the bladder, were involved. Renal calculus has often been found in association with these tumors.

The symptoms, prognosis, and treatment are the same as in the other malignant tumors of the kidney.

¹ Kelly, A. O. J.: "Papillomatous Epithelioma of the Pelvis of the Kidney," *Proc. Path. Soc. Phila.*, 1900, N. S., vol. iii, No. 9, p. 217.

Adrenal Tumors.—Adrenal tumors are exceedingly malignant. They are rapid in growth and are complicated by lymphatic and visceral metastases very early. As they increase in size they push the kidney downward. Pain from pressure on the spinal nerves at their exit from the intervertebral spaces may be an early symptom. The proximity of the growth to the pleura and to the vena cava on the right side explains the frequency of early pleural extensions and venous stasis. The pressure of the tumor may produce urinary symptoms like those of a kidney tumor, and a diagnosis before exposure between an adrenal and a renal tumor is almost impossible. Unless undertaken very early and the tumor is without extensions, extirpation should not be attempted.

Pararenal Tumors.—According to Küster, the symptoms and the course of tumors affecting the kidney capsule and its environs differ from those of the kidney itself. They are never associated with alterations of the urine. The only important symptom is the appearance of a palpable tumor in the abdomen. This is felt beneath the border of the ribs, and during its growth further downward. It may be smooth or knobby; it feels hard, doughy, or in the case of soft lipomata or myxomata there may be indistinct fluctuation. Its position corresponds to that of a kidney tumor, and it may be fairly mobile. There may be digestive disturbances, constipation, dyspnea, emaciation, cachexia, and edema of the legs. A pararenal tumor may be distinguished from paranephritis by the absence of inflammatory symptoms and the disassociation with renal calculus, pyonephrosis, and pyelonephritis.

The prognosis of these tumors is bad. Without operation they are almost invariably fatal. The operative removal is very difficult. Küster reports that operation was undertaken in fifty-six out of seventy cases, but the difficulty of operation was so great that eleven of the fifty-six operations were incomplete; of these eleven cases, ten died at the close of operation or lived for a very short time. In the remaining forty-five cases, seventeen died as a direct result of the operation.

Cystic Tumors of the Kidney.—*Simple or Retention Cysts.*—Simple cysts spring from the outer region of the cortex and are bordered by the compressed parenchyma of the kidney. Contracted kidney is often associated with simple cysts. They may be multiple, they are usually solitary, and they are never grouped.



FIG. 849.—PAPILLARY CARCINOMA OF KIDNEY.

Two contiguous cysts may unite by the destruction of an intervening septum. They arise either from the capsule of Bowman or from a kidney tubule. Many never attract any attention and scarcely more than half of them could be detected by palpation, if deliberately sought. The cyst may, however, grow to an enormous size. The symptoms are those of nephritis, pressure, and tumor. The preferable treatment is partial nephrectomy. If this is not feasible, incision and drainage or total nephrectomy is indicated.

Polycystic Disease of the Kidney.—Polycystic degeneration of the kidney may be noticeable at birth or it may appear later in life. If congenital, it is often accompanied by other deformities of the urogenital apparatus. The form which appears in adults usually develops from an adenocystoma and destroys the renal tissue.

Küster compares the external appearance of a polycystic kidney to a bunch of grapes (Fig. 850). The vesicles of larger and smaller size are often found closely in relation to one another. In other cases the cysts are less numerous and rests of healthy kidney tissue are found between them. In some cases the degeneration is confined to a certain spot, *e. g.*, one pole of the kidney. The size of the individual cyst varies from one barely visible to one having the circumference of a hazelnut. In the cortical substance the cysts are usually round; in the medulla they are frequently elongated or sausage-shaped. Alterations may be found in the ureter, the kidney pelvis, and the kidney calyces. The calyces and the pelvis are sometimes almost fully replaced by connective tissue. The upper part of the ureter may be changed into a solid string; at other times the ureter is only narrowed, and the wall is concentrically thickened.

Symptoms.—Israel divides cases of polycystic disease into four groups, depending on the symptoms which they present. In the first group there are no indications of renal involvement until uremia makes its appearance. In the second, there are polyuria, occasionally hematuria, dysuria, great thirst and dryness of the mouth, and slight edema. A third class may show particularly disturbances of the circulatory apparatus, such as palpitation, dyspnea, and vertigo. Other cases seek medical advice because of distention of the abdomen with a feeling of tension, anorexia, vomiting, and digestive disturbance.

A palpable tumor in one or both kidney regions has been observed in one-third of the entire number of cases. Under favorable conditions it is possible to determine that the surface of the organ is covered with small knobs varying in size from a pea to an egg.

Diagnosis.—It may be difficult to distinguish this sort of a kidney tumor from hydronephrosis and new-growths. Hematuria is neither so frequent nor so severe as in malignant tumors of the kidney. A surface covered with small knobs of considerable hardness is a good indication of cystic kidney, but it may also be due to multiple new-growths, stone, tuberculosis, or a lobulated kidney of fetal origin. When the diagnosis is doubtful, an exploratory incision is indicated.

Prognosis.—Although some cases of cystic kidney give rise to no great trouble,

being found at autopsy in patients eighty to ninety years old, most of them occasion



FIG. 850. —POLYCYSTIC DISEASE OF THE KIDNEY.

symptoms and end more or less quickly in death. No form of treatment up to this time has improved the prognosis in any great measure; usually the outlook is bad.

Treatment.—The treatment should be medical and not operative. Nephrectomy is dangerous on account of the frequency with which the disease is bilateral. Nephrotomy effects no permanent reduction in the enlargement of the kidney and does not influence the course of the disease. It is better to treat the case by medical means as one of contracted kidney.

Adenocystoma.—Adenocystoma of the kidney may be benign or malignant. The benign form resembles and may be the early stage of polycystic kidney disease, and demands the same treatment. Malignant adenocystoma presents all of the general features of the other malignant renal growths. Hematuria, renal colic, and local urinary symptoms are more pronounced than in the benign form. An exploratory incision, however, may be required before a differential diagnosis can be made.

Pararenal Cysts.—Cysts of the capsule or of the bordering connective tissue may be: blood cysts resulting from trauma; epithelial cysts due to evagination of the kidney pelvis; lymph cysts; cysts from displaced rests of the Wolffian body; dermoid cysts. A great number of the reported cases have been found at autopsy; their only evidence is a tumor, which careful examination will show has a connection with the kidney. The prognosis is very good. Küster reports thirteen cases treated surgically; only one ended in death, and this was in a man of seventy years.

Echinococcus Cysts of the Kidney.—White and Martin state that the kidney is affected in 5.8 per cent. of all cases of hydatid disease. The condition develops slowly and forms a smooth, round, movable tumor of the kidney. The tumor may be hard or semi-fluctuant. The urinary constituents are not much affected unless the cyst bursts into the pelvis, when hooklets and daughter cysts are found in the urine. Suppuration may occur in the cyst either from trauma or from infection after rupture into the kidney pelvis. Usually there is little pain, but if the cyst bursts into the pelvis there may be renal colic. The treatment is incision and suture of the sac wall to the lumbar wound after removing the contents of the sac. This applies to clean as well as to suppurating cases. Resection may be done in aseptic cases if the situation of the cyst is favorable.

RENAL NEURALGIA.

Pain in the region of the kidney is not always due to a renal affection. Thus the pain of intercostal and muscular neuralgia, irritation of the posterior spinal nerve-roots from any cause, lumbago, spinal caries, abdominal aneurism, pleuropneumonia, and duodenal ulcer may be referred to the loin. A form of pain closely simulating renal colic is said to be due to malarial poisoning. Neuralgic reflex pain is sometimes observed in the right lumbar region in cases of hypertrophy of the left ventricle, the result of aortic regurgitation. Pain in the loin has also been due to engorgement and enlargement of the kidney at the menstrual period, and acid urine may produce not only lumbar pain but also frequent micturition and even a slight amount of pus or blood in the urinary excretion. The differential

diagnosis between these conditions and actual renal disease is usually made by observing the course of the affection and the result of certain plans of treatment.

In some cases no renal disease can be discovered, and yet the physician is finally forced to the conclusion that the pain is actually renal in origin. In this event exploratory nephrotomy is justifiable as a last resort, and even though no lesion of the kidney is found, the relief of tension which follows section of the kidney capsule has often cured the patient. It is probable that in some cases where no gross lesion is found at operation a microscopic examination of the tissue of the kidney would show some form of Bright's disease.

RENAL HEMORRHAGE OF UNEXPLAINED ORIGIN.

Cases have been reported from time to time of renal hemorrhage in which no pathologic condition of the kidney could be found. Klempner believes that such cases are examples of a disturbance in the vasomotor fibers of the kidney causing a dilatation of the blood-vessels and a consequent diapedesis of the red blood-corpuscles.

Schenck¹ reported a case of this sort in which every means was exhausted to find out what produced the hematuria. Examination was absolutely negative, and the bleeding disappeared four



FIG. 851.—UNILATERAL CYSTIC KIDNEY (Cullen's Case); $\frac{1}{2}$ natural size.

¹ Schenck, Benjamin R.: "Renal Hematuria of Unexplained Origin; Report of a Case with Cessation after Nephrotomy," *Med. News*, 1904, vol. lxxxv, p. 1206.

weeks after the operation and had not reappeared at the time the report was made, two years later. Schenck believes that many cases of so-called idiopathic renal hemorrhage have not been sufficiently examined. Before such a diagnosis can be rightly made, the kidney must be split from end to end and a portion of the cortex subjected to a microscopic examination. He thinks that it would be far more scientific to put such cases aside as unexplained than to admit them under the classification of idiopathic hematuria.

SURGICAL TREATMENT OF DISEASES OF THE KIDNEY.

The operations performed for diseases of the kidney comprise:

1. Incision into the paranephric area.
2. Nephropexy.
3. Decortication of the kidney.
4. Nephrotomy.
5. Nephrotresis.
6. Nephrolithotomy.
7. Nephrectomy, total and partial.
8. Nephro-ureterectomy.

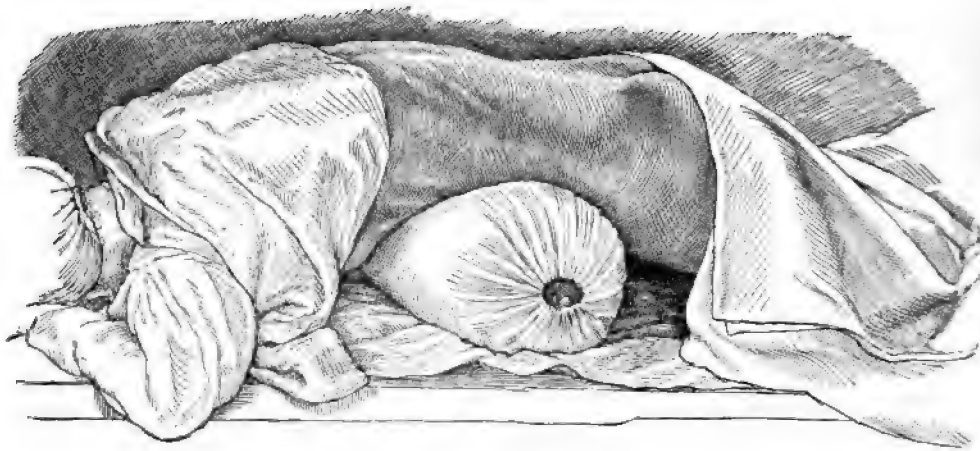


FIG. 852. —EDEBOHLS' POSITION.

The conditions which indicate the performance of these operations include the entire field of surgical diseases of the kidney, and one of the operations—namely, decortication—has been recently used for certain forms of chronic disease of the kidney formerly relegated to the domain of medicine alone.

General Remarks on Kidney Operations.—The indications for operation have already been given in the paragraphs devoted to the various kidney lesions. The preparatory treatment of the patient is very much like that for a laparotomy. The urinary excretion deserves particular attention, and any abnormalities should

be corrected as far as possible. The preparation of the intestinal tract and the local disinfection of the skin overlying the operative area is the same as for any major operation.

Position of the Patient.—As a rule, the prone position is the most convenient, the abdomen being supported by a firm pillow or an Edebohls cushion, which flexes the spine and increases the distance between the lower border of the ribs and the crest of the ilium (Fig. 852). For lumbar nephrectomy or nephro-ureterectomy the patient should occupy a lateral position with a cushion beneath the loin of the opposite side. In a transperitoneal operation on the kidney the ordinary dorsal position is used.

Post-operative Treatment.—There is little in the post-operative treatment that is peculiar to kidney cases, the usual care of a laparotomy being suitable here. Although post-operative intestinal distention is not uncommon, probably from trauma to the adjacent large gut, there is less danger of peritonitis. The functional activity of the kidneys may be a source of anxiety, especially after nephrectomy and after nephrotomy for stone, and for this reason large quantities of water should be exhibited by the mouth and rectum. Following nephropexy it is advisable to keep the patient in bed for three weeks. After the other operations the patient may be allowed out of bed, if the general condition permits, at the end of ten days. The bowels should be moved after the second day, by using the measures already described for laparotomies.

Incision for Exposing the Kidney.—There are a number of incisions for exposing the kidney, some of them especially suited to certain operations.

Edebohls' incision (Fig. 853) is suitable for nephropexy, for decapsulation of the kidney, and for nephrotomy.¹ With the patient in the prone position, the cushion underlying and supporting the abdomen, an incision is carried from the twelfth rib to the crest of the ilium, along the outer margin of the erector spinæ, without opening the sheath of that muscle. The fibers of the quadratus lumborum muscle are bluntly separated in their course without cutting, or preferably the muscle is displaced inward. The iliohypogastric nerve is sought for in front of and along the outer margin of the quadratus, and turned to one side out of the way of danger; the transversalis fascia is divided, exposing the perirenal fat, which is caught with artery forceps and divided well to the inner and posterior part of the wound in order to avoid the colon. The separation of the perirenal fat is completed by means of the finger until the kidney is felt in the depths of the wound and seen.

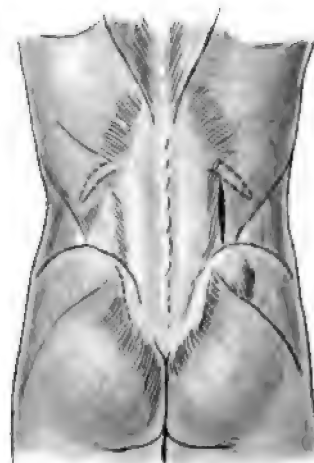


FIG. 853.—EDEBOHLS' INCISION.

¹ Edebohls, George M.: "The Cure of Chronic Bright's Disease by Operation," *Med. Record*, 1901, ix, 961.

Robson's incision is suitable for nephrotomy and for nephrectomy. It has the advantage of exposing the kidney by splitting the muscles in their course, without dividing muscle fibers or weakening the abdominal wall, and without wounding



FIG. 854.—ROBSON'S INCISION.

vessels or nerves. Robson's¹ operative incision (Fig. 854) is begun to the inner side of the anterior superior spine of the ilium, and is carried backward obliquely toward the tip of the last rib. The fibers of the external oblique and its aponeurosis are separated and retracted, exposing the internal oblique muscle, the muscular fibers of which are split on a line between the ninth costal cartilage and the posterior superior spine of the ilium, in which position they are longer than in front or behind that line. The fibers of the transversus are split and retracted along with the oblique muscle.

A diamond-shaped space is thus formed, at the bottom of which is seen the transverse fascia; this is incised, exposing the perirenal fat, and on pushing through the fat the kidney is easily reached in whatever position it may lie. This incision gives plenty of room, and if needful the whole hand can be introduced into the circumrenal space.

If it becomes necessary to expose the ureter, the incision may be continued obliquely downward toward Poupart's ligament. The internal oblique will then require suture to bring together the divided ends. Preferably a second lower incision through the outer border of the rectus muscle may be made to reach the ureter.

Kelly's Incision.—Kelly finds the superior lumbar triangle the most satisfactory avenue for the exposure of the kidney except in malignant cases (Fig. 855). The boundaries of the triangle are the posterior margins of the oblique muscles of the abdominal wall, the quadratus lumborum, and the twelfth rib. Its floor is formed by the aponeurosis of the oblique muscles and the latissimus dorsi covers it. The oblique incision which Kelly uses is about three inches long, extending downward and outward from the little soft yielding spot in the angle between the quadratus lumborum and the rib, exposing the latissimus, which can be lifted up like a lid or separated in the direction of its fibers or simply divided transversely. The whitish area of the apex of the triangle is thus exposed. A pair of closed forceps is then pushed through the aponeurosis and withdrawn, when the golden-yellow

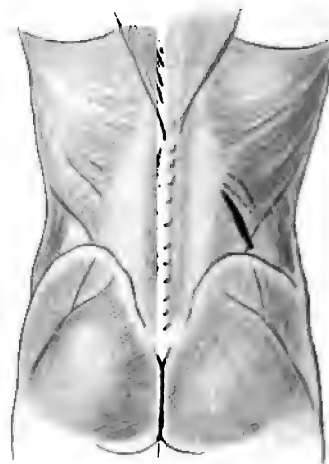


FIG. 855.—KELLY'S INCISION.

¹ Robson, A. W. Mayo: "A Method of Exposing and Operating on the Kidney without Division of Muscles, Vessels or Nerves," *Lancet*, 1898, May 14, p. 1315.

fat pops out. The opening is enlarged by blunt force, giving command of the entire field without the ligation of a single vessel. Enlargement of the incision is easily effected by further separating the oblique muscle fibers, or by dividing them in a direction downward and outward. Care must be taken not to injure either the last dorsal or the first lumbar nerve.

Morris' Incision for Nephrolithotomy.—Morris exposes the kidney by an incision (Fig. 856) starting about three-fourths of an inch below the last rib, at the outer border of the erector spinæ, running parallel to the rib or in a slightly more downward direction for about four and a half inches. "The structures divided are the skin, the superficial fascia and the fat, the outer border of the latissimus dorsi, and the posterior border of the external oblique; the internal oblique and the lumbar fascia are exposed and divided to the full extent of the wound. The last dorsal nerve and the subcostal artery with its vein run along the lower border of the last rib and usually escape being divided, but not infrequently they pierce the lumbar fascia and take a lower course, when they may cross the line of incision. If so, they are best divided, the artery being ligatured and an inch or more of the nerve excised. If the last dorsal nerve after keeping along the lower edge of the last rib pierces the muscular fibers of



FIG. 856.—MORRIS' INCISION FOR NEPHROLITHOTOMY.

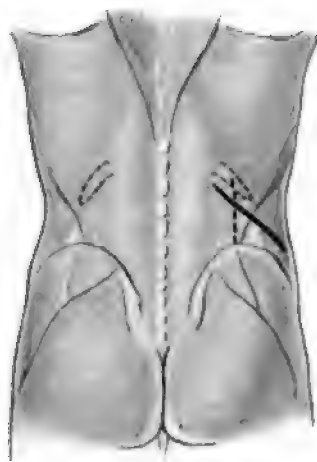


FIG. 857.—MORRIS' INCISION FOR NEPHRECTOMY AND LINE OF SECONDARY INCISION.

the transversalis instead of the fascia lumborum, it will escape; but the lateral cutaneous branch of the last dorsal nerve, which pierces the external and internal oblique muscles and takes an oblique course to the crest of the ilium, is necessarily divided. The trunk of the iliohypogastric nerve is usually below the line of incision and is not seen. Its hypogastric branch lies parallel to the incision, in front of the iliac spine and below it, and is not divided unless the incision is carried as far inward as the external abdominal ring, where the nerve may be cut near its termination.

The lumbar fascia, and at the front of the wound some of the fibers of the transversalis fascia, are divided to the full extent of the incision. This should be done very carefully, because in thin subjects the peritoneum is close beneath the transverse muscle and very adherent to the intervening fascia. The outer edge of the quadratus lumborum is exposed, and if the muscle is broad, it should be divided as far back as the limit of the skin incision. The transversalis fascia should be

divided, and when this is done, a smooth and glistening cellulo-fibrous sheath of paranephric fascia containing the fatty capsule of the kidney will bulge into the wound at the back, and the subperitoneal fat will be seen further forward." As the perinephric fascia may easily be mistaken for the peritoneum, it should be a rule to cut into the fascia at the posterior extremity of the wound near the erector spinæ.

Morris' Incision for Nephrectomy (Fig. 857) is the same as the one used for nephrotomy, but in order to gain more room, he sometimes joins to the first incision, about an inch in front of its posterior extremity, another one running vertically downward or upward. This secondary incision may be left until the kidney has been reached and explored, and it can then be made by cutting from within outward with a probe-pointed bistoury steadied by the index-finger of the left hand. The vertical incision greatly facilitates the passing of the ligature around the pedicle. An upper cut markedly increases the room by dividing the fibers of the ligament of Henle, the lower end of which hampers the fingers during the enucleation of the organ. In certain cases more or less advantage is gained by excising a large part of the twelfth rib.

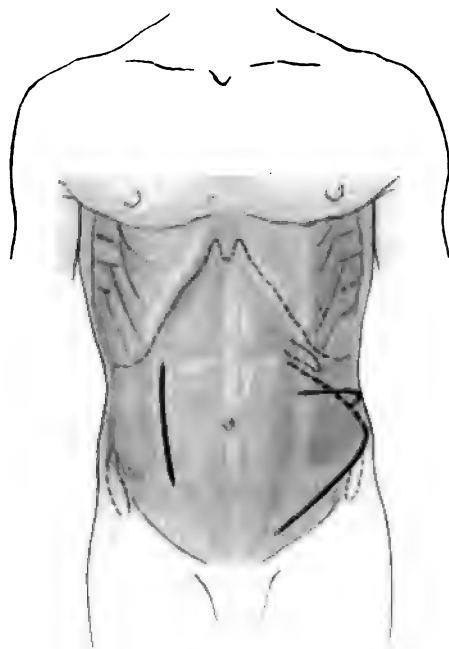


FIG. 858.—LANGENBACH'S INCISION AND ISRAEL'S SECONDARY INCISION FOR NEPHRECTOMY AND LITHOTOMY.

Langenbuch's Incision; Transperitoneal Incision.—Langenbuch¹ practised removal of the kidney through the incision used in less modern times for celiotomy. The incision runs along the outer border of the rectus muscle of the affected side. Its mid-point should correspond to the center of the kidney mass. It is used for transperitoneal or abdominal exposure of the kidney.

Israel's Incision.—Israel² exposes the kidney by an oblique incision, beginning at the junction of the erector spinæ with the twelfth rib, running forward and downward to a point two or three fingerbreadths to the median side of the anterior superior spine of the ileum (Fig. 859). This direction has the advantage of exposing the upper segment of the ureter. If it is desirable to expose this further downward toward the bladder, the incision is lengthened from its lower end downward and forward parallel to Poupart's ligament. To palpate the ureter as far as its insertion

¹ Langenbuch: Discussion of Barwell's paper on Nephrectomy, Trans. Internat. Med. Congress, 1881, p. 278; "Demonstration eines wegen rechtsseitigen Nierencarcinoms glücklich laparotomirten Knaben," Deutsch. med. Wochenschr., 1885, xi, Nr. 48, S. 838.

² Israel, James: "Chirurgische Klinik der Nierenkrankheiten," Berlin, 1901.

into the bladder, the incision may be lengthened to the outer border of the rectus, or to operate on the vesical section under good exposure the rectus may be incised. If this incision does not give sufficient room in difficult nephrectomies, Israel uses a second incision (Fig. 858)—a transverse, beginning two fingerbreadths below the border of the ribs, and running anteriorly toward the rectus muscle at right angles. Israel's incision is especially applicable to nephrolithotomy and nephrectomy.

Special Observations Relative to Kidney Operations.—Before operating on any case in which nephrectomy might come up for consideration, it is desirable to ascertain the functioning power of each kidney. In every case it is essential to know whether the urinary excretion is abnormal either in quality or quantity, and if it is abnormal to determine whether one or both kidneys are affected. The total functioning capacity of the two kidneys is revealed by cryoscopic examination of the urine and the blood and by the estimation of the excretion of urea. The functional condition of each particular organ can be demonstrated with the help of ureteral catheterization.

Ureteral Catheterization.—The technic of ureteral catheterization in women is given in Chapter VIII, vol. I, p. 449. For the technic of the catheterization of the ureters in men the reader is referred to standard treatises on genito-urinary diseases.

Indigo-carmin Test.—The indigo-carmin method is useful in the catheterization of the ureters. For the beginner it serves to locate the ureteral orifices by the blue stream of urine, and it aids the more skilful examiner when the openings are indistinct. For an adult the dose is 80 mg.; 20 cm. of a 0.4 per cent. solution of indigo-carmin in 0.6 per cent. salt solution should be injected into the gluteal muscles. The blue color appears in the urine after five to ten minutes. The ingestion of much fluid will dilute the urine and make the test less satisfactory. Consequently for several hours previous to the injection only a slight amount of fluids should be taken.¹

Determination of the Renal Function.—In order to estimate the functional activity of the kidneys, there are several tests which may be employed.

Determination of the Amount of Urea.—A functional incapacity of the kidney may be assumed if the quantity of urea in the urine persistently falls below normal. The usual excretion varies between 20 and 25 grams a day. If the urea excreted in the twenty-four hours is less than 15 grams, it may be assumed that an insufficiency of the kidney exists to such an extent that nephrectomy is inadvisable. A single determination of the amount of urea is not conclusive; but if the figures



FIG. 859.—ISRAEL'S INCISION.

¹ Voelcker, Fritz: "Diagnose der chirurgischen Nierenerkrankungen unter Verwertung der Chromocystoskopie," 1906, Wiesbaden.

obtained in a series of consecutive days, the patient taking the proper amount of nourishment, are approximately identical, the results are trustworthy.

Phloridzin Test.—This method depends upon the fact that after a subcutaneous injection of from 1 to 1.5 mg. of phloridzin there is an excretion of sugar, if the kidneys are healthy, in from fifteen to twenty minutes; a sugar reaction is shown much later or not at all if the kidneys are diseased. Ureteral catheters may be placed in each kidney, so that the sugar reaction can be taken from each independently.

Cryoscopy.—Cryoscopy is the determination of the freezing-point of the urine and of the blood. According to Kümmell, it is the best method of ascertaining the functional activity of the kidneys. The idea on which the method is based is that the physiologic activity of the kidney must be considered as a form of osmosis, and that the work of the kidney may be calculated from its product, the urine, and the source of its product, the blood-serum. The osmotic concentration of the blood or the urine is calculated from the freezing-point. The more concentrated a solution, the further the freezing-point is below that of distilled water. To correctly estimate the freezing-point of the blood, a skilled examiner is absolutely necessary, and a failure to insist upon this point will lead to untrustworthy reports. The details of the technic used by Kümmell are fully described in his paper (*l. c.*), to which the reader is referred.

He has drawn the following conclusions, based upon seven hundred cases: When the kidneys are healthy, the molecular concentration of the blood is constant, and, on the average, corresponds to a freezing-point of $.56^{\circ}$ C. In weakened and anemic individuals an increase to $.55^{\circ}$ C. and even to $.53^{\circ}$ C. and $.52^{\circ}$ C. is sometimes observed. Unilateral disease causes no change in the freezing-point of the blood. The normal freezing-point ($.56^{\circ}$ C.) proves only that so much functioning kidney tissue is present as is necessary to excrete sufficiently the products of tissue metabolism. Because in a given case one kidney may be doing the work of two, and because the normal freezing-point of the blood does not indicate two healthy kidneys, ureteral catheterization should be performed and positive determination of urinary excretion from each kidney should be made. A normal amount of urea and a normal freezing-point of the urine are invariably associated with a normal freezing-point of the blood. A lowering of the freezing-point of the blood indicates that the kidneys are not entirely equal to the required work. If the freezing-point of the blood falls to $.6^{\circ}$ C., according to Kümmell's experience, nephrectomy should not be undertaken and nephrotomy only when it is absolutely necessary.

Nephrectomy may be performed secondarily if the freezing-point has improved and reached the normal. Otherwise nephrectomy should not be considered. In five cases in which nephrectomy was performed notwithstanding a lowering of the freezing-point below $.6^{\circ}$ C., death from uremia occurred after a short time. In about three hundred cases in which the freezing-point was lowered below $.6^{\circ}$ C. the further course of the disease and the post-mortem examination or nephrotomy proved the correctness of Kümmell's beliefs.

Without ureteral catheterization the condition or even the presence of the second kidney must often remain in more or less doubt. An example of this is recorded by Keen and Stewart,¹ a case of calculous pyelitis in which nephrotomy was performed instead of nephrectomy, examination of the urine showing a diminution in the excretion of urea. Because of the low excretion of urea, an apparently almost destroyed and useless kidney was left *in situ*. Following operation the amount of urine from both kidneys was carefully estimated, and it was found that the kidney operated on secreted about four and a half times as much urine as the other kidney. In this case ureteral catheterization could certainly have shown the condition previous to the operation.

When for one reason or another the condition of the second kidney is doubtful, the plan of Edebohls² may be adopted. This author says that before extirpating any kidney, a knowledge of the presence and condition of the other kidney is of paramount importance, and that none of the usual aids are as valuable as an exploratory incision. "Delivery and examination of both kidneys, by lumbar exploratory incision, should be the rule in every contemplated nephrectomy in which one is not absolutely and beyond peradventure certain of the condition of the other kidney. Modern surgery has rendered lumbar exploratory incision a safe and expeditious procedure, the most and generally the only reliable way of determining the exact condition of the other kidney."

Incision into the Paranephric Area.—For the exposure of the paranephric tissues and for the opening of a paranephric abscess, either the incision of Morris or of Kelly, or the primary incision of Israel, may be used. If fluctuation or tumor is present, incision should be made over the most prominent point. In advanced cases of paranephric abscess the pus may be reached almost immediately beneath the skin; in others, the incision will have to be carried deeper and very often the tissues will be hard and indurated. After exposing the paranephric fat, unless pus is encountered at once the finger should be passed in different directions to locate the abscess.

If no pus is found, the incision should be carried as far as the fibrous capsule of the kidney, and especial attention should be given to the areas surrounding the upper pole and the lower posterior border, where abscesses are most likely to be overlooked. When the abscess is opened, the pus usually discharges readily. In some cases it comes away less freely, being thick and caseous. In any event the abscess cavity should be thoroughly washed out and smaller secondary cavities should be broken into the larger one.

It is nearly always desirable to determine the condition of the kidney. If, however, the organ lies entirely separated from the collection of pus, and if its exposure presents much difficulty, simple incision and drainage of the paranephric pus cavity will suffice unless exploration is demanded by the kidney symptoms.

¹ Keen, W. W., and Stewart, D. D.: "Nephrotomy for Calculous Pyelitis," *Therapeutic Gaz.*, Jan. 15, 1892, viii, p. 27.

² Edebohls, George M.: "The Other Kidney in Contemplated Nephrectomy," *Ann. Surg.*, April 18, 1898, xxvii, p. 425.

Keen¹ use the fatty capsule as a means of suspension, removing a certain amount and suturing the remainder to the incision.

If the capsule proper of the kidney is to be used as a means of suspension, it is nicked over the dorsum of the kidney, a grooved director thrust between the capsule and the kidney substance, and the former divided to as great a distance as desired. Edebohls strips it equally from both surfaces, half-way to the hilum, and sutures

the capsule on both sides to the borders of the incision through the anterior layer of the lumbar fascia which covers the quadratus lumborum muscle. This brings the raw surface of the kidney directly in apposition with the exposed fibers of the quadratus lumborum muscle.

Experience has shown that at times severe pain in the kidney is cured by a nephrotomy incision. This fact should be borne in mind and the capsule stripped in those cases of nephropexy in which pain has been a prominent symptom of the loose kidney.

Hahn strips the fibrous capsule of the kidney from the posterior surface only. He then sutures the borders of the incised fatty capsule to the depths of the incision, while the flap of fibrous capsule is pulled out through the incision and sutured either to the skin or to the subcutaneous tissue. The wound is packed with gauze.

There is some question whether sutures in the kidney parenchyma are harmful. Delhaes, in 1882, was the first to place sutures in this position. According to Keen, the passage of such sutures has been found to do no harm by Bassini, Vanneufville and Tuffier. On the other hand, Senn² credits Delageniere, Zatti, and Albarran with having shown that sclerotic connective tissue forms in the vicinity of these sutures with a corresponding destruction of the kidney parenchyma.

Edebohls, Boldt,³ Montgomery,⁴ and Villeneuve have reported instances of

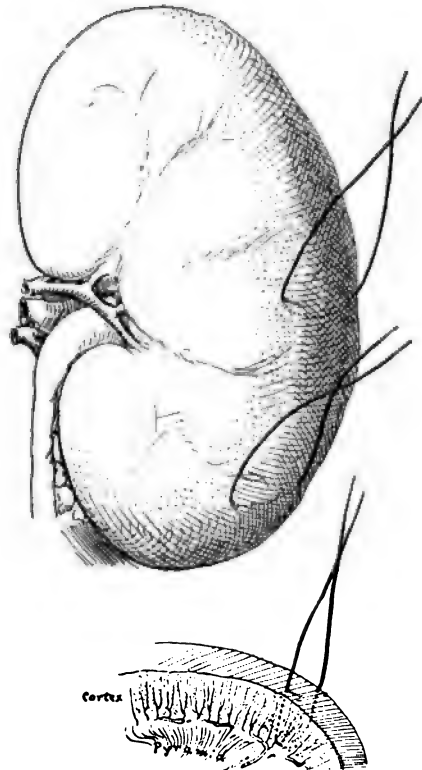


FIG. 862.—OLD METHOD OF PASSING SUTURES INTO KIDNEY SUBSTANCE IN NEPHROPEXY.

Observe how any strain upon the suture would be met with little resistance, the connective-tissue reticulum and the blood-vessels of the kidney cortex running parallel with the suture.

¹ Keen, W. W.: "Nephrorrhaphy." *Ann. Surg.*, Aug., 1890, vol. xii, p. 81.

² Senn, Nicholas: "Lumbar Nephropexy without Suturing," *Jour. Amer. Med. Assoc.*, 1897, xxix, p. 1190.

³ Boldt, H. J.: "A Case of Nephrorrhaphy Followed by Urinary Fistula and Salpingo-oöphorectomy," *N. Y. Jour. Gynec. and Obstet.*, 1893, vol. iii, No. 2, p. 145.

⁴ Montgomery, E. E.: Discussion: *Trans. Phila. Obstet. Soc., Amer. Gynec. and Obstet. Jour.*, 1900, vol. xvii, No. 6, p. 541.

extravasation of urine along the suture tracts, when sutures have been passed directly through the kidney substance. While this is a very rare accident, it forms the basis of a legitimate objection to the method. The chief disadvantage in direct suture of the kidney is the decided risk of the sutures cutting out, as the organ is so friable.

Max Brödel¹ has devised a suture which inflicts a minimum amount of traumatism and at the same time securely fixes the kidney to the lumbar muscles. He describes it as follows:

1. The direction of the suture is not parallel, but at right angles to the framework of the cortex.

2. The fibrous capsule being the most resistant structure is utilized instead of the kidney substance itself to furnish the main support for the suture.

3. The suture is passed in the form of a triangle through the cortex so as to leave two suture bridges on the surface of the kidney (Fig. 863). These bridges bear the brunt of the work, and traction on the suture is borne by them instead of by the circulatory or the secretory structures of the kidney. To make the Brödel suture tear, the bridge must pull the fibrous capsule into the cortical substance of the kidney, a procedure requiring considerable force. In a series of experiments simple through-and-through sutures of the kidney parenchyma tore out with a weight of 800 to 1000 gm.; the Brödel suture held without tearing either capsule or cortex at 3000 to 3200 gm. It is superior to any yet devised, and has been extensively used with very good results.

When a movable kidney is sutured to the lumbar muscles on a plane with the incision, the organ is below its normal position. Those operators who attempt to

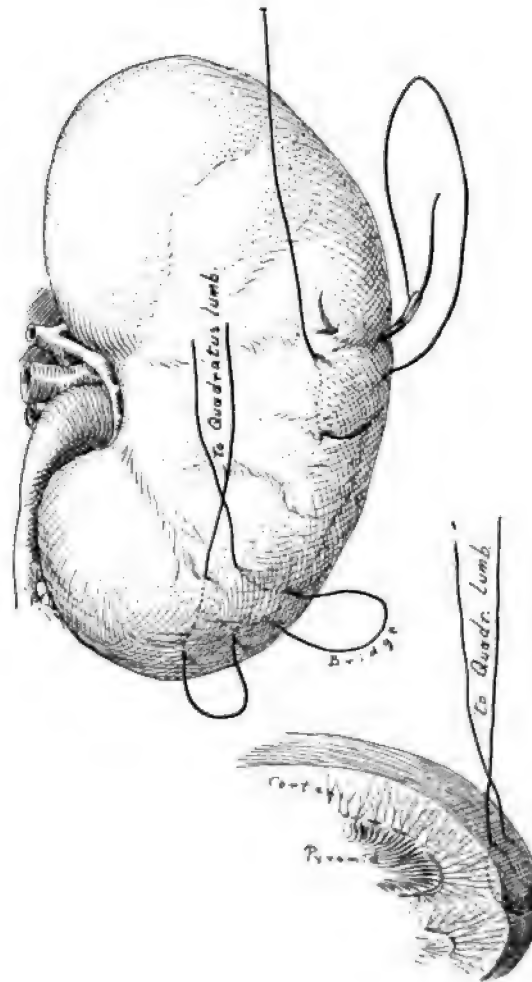


FIG. 863.—THE BRÖDEL SUTURE.

Observe that the pull of the suture is at right angles to the connective-tissue reticulum and the blood-vessels in the cortex, and that the suture is further supported by the bridge overlying the kidney capsule.

¹ Brödel, Max: "A More Rational Method of Passing the Suture in Fixation of the Kidney," *Amer. Medicine*, 1902, vol. iv, No. 5, p. 176.

place the kidney in a normal position pass their sutures through the lower half of the kidney and anchor them high in the lumbar incision, so that the upper part of the kidney rests beneath the lower ribs (Fig. 864). Indeed, the last rib has been resected in an effort to fix the kidney in its original site. Those who are content to anchor the kidney at the position of the lumbar incision have found it entirely satisfactory. It permits fixation of both poles equally, so that no tilting of the kidney occurs, and no interference with its vascular supply or with the urinary outflow is possible, as pointed out by Morris, Edebohls, Keen, and Dunning.

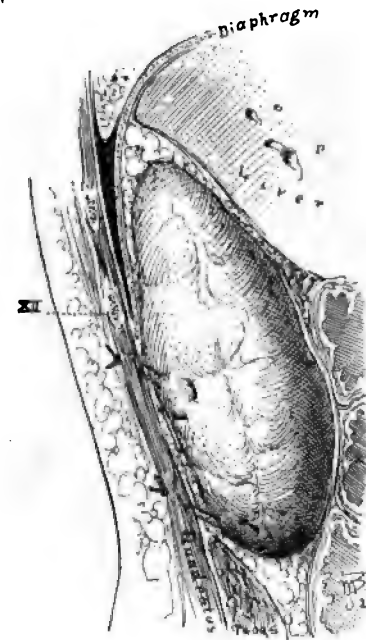


FIG. 864.—SHOWING THE KIDNEY FIXED TO THE QUADRATUS LUMBORUM BY THE BRÖDEL SUTURE, AND THE PULL OF THE SUTURE MORE OR LESS AT RIGHT ANGLES TO THE KIDNEY CORTX.

The picture represents the kidney suspended in its normal position, the upper pole beneath the ribs and the fixation sutures passed through one surface of the lower pole. In the usual nephropexy the sutures are passed through both poles and the organ is fixed in a lower position than normal.

Dunning thinks it is desirable to displace the kidney downward to the lowest limit of its respiratory range, in order to relieve it from undue diaphragmatic pressure. None of the operators quoted, except Hahn, who fixes the kidney by means of sutures, employs drainage.

Senn does not use sutures. He excises a portion of the fatty capsule and packs gauze between the bared capsula propria and the surrounding tissues, for the purpose of exciting adhesions. The patient is kept in bed four or five weeks. Senn's operation or the principle of his operation has been variously modified. The best is that of Penrose and Beyea, who pass a rubber tube around each pole of the kidney. The fatty capsule is disposed of so that traction on the tubes will hold the surface of the kidney against the lumbar muscles. The wound is closed except at its upper and lower extremities, where the tubes emerge. Traction is maintained by tying the tubes over a strip of gauze covering the incision. The first dressing is made on the tenth day. The tubes come away without difficulty on the twenty-first day, and the sinuses resulting close in three to four days. By this procedure two fibrous cords are produced uniting the kidney firmly to the lumbar muscles.

The subject of technic has been rather extensively presented in order to give an epitome of

the best ideas that have been advanced. Noble's technic is as follows: The patient lies prone upon the table. The Edebohls air-cushion is placed exactly beneath the epigastrium. If too low, it will tend to displace the kidneys under the ribs; if too high, it does no good. The incision is made along the external border of the erector spinæ muscle from the twelfth rib toward the ilium. It should be about three inches in length. When the muscles are reached, they should be separated as far as possible rather than cut, in order to preserve the

integrity of the posterior wall of the abdomen. It is usually necessary to ligate cut vessels, as these are much larger than in the anterior wall. Care should be taken to avoid wounding the iliohypogastric and ilio-inguinal nerves, which run through the field of operation in a direction about parallel with the border of the quadratus lumborum muscle. If one of these be cut, it sometimes causes annoying paresthesia in the region of its distribution. When the muscles have been well separated, the subjacent fascia is divided, exposing the perirenal fat. This is drawn outward and downward and torn through as near the spinal column and as high in the wound as convenient, the object being to deflect this layer of perirenal fat outward and downward, so that at the conclusion of the operation it will form a cushion below and to the outside of the sutured kidney.

After the fatty capsule is torn through, the kidney as a rule comes into view. If not, it is either below the field of operation or it has slipped up under the ribs. When the kidney is very movable and the Edebohls pad is used, it is not uncommonly displaced downward toward the pelvis. Rolling the patient on the pad will sometimes bring the kidney within reach. The kidney is drawn out by hooking a finger under its upper pole, teasing it out through the incision. The fatty capsule is stripped off from its external border, upper and lower poles, and lateral surfaces. The region of the hilum is best not disturbed, in order to avoid the renal vessels.

Four sutures of silk, celluloidin thread, or chromicized catgut are used. The principle of the Brödel stitch is employed, but the sutures take in a larger inverted V than is shown in the illustration of the Brödel method (Fig. 868). Two sutures are introduced on each side of the kidney, preferably by means of a straight sewing-needle. When it is not feasible to deliver the kidney, the sutures can be passed

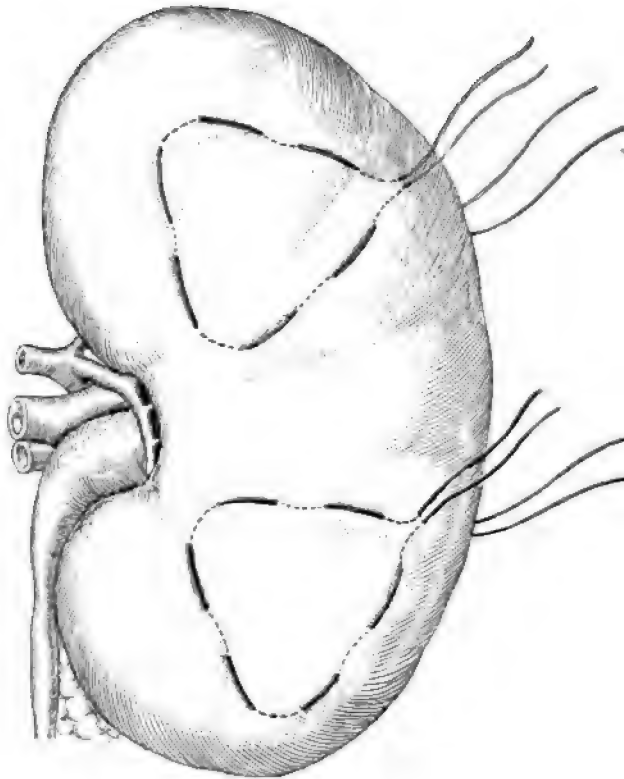


FIG. 868.—THE MODIFIED BRÖDEL SUTURES INTRODUCED.

Securing the kidney at the same relative position as in Edebohls' nephropexy, one on each surface of the kidney at the upper and the lower pole.

better with a curved needle and a needle-holder. As a general rule, the sutures are passed while the kidney is lying outside. The ends of each suture are caught with an artery forceps. The kidney is now replaced, taking care to see that there is no twisting of the pedicle. It is best at this stage to allow a part of the air to escape from the nephrorrhaphy pad, in order to lessen intra-abdominal pressure.

The ends of the kidney sutures are now passed with a carrier from within outward through the lumbar muscles, the upper sutures being inserted as close to the last rib as possible. Two sutures are passed through each side of the wound and the knots are tied just external to the deep fascia. Between each pair of fixation sutures a chromicized catgut interrupted suture is passed to close the wound in the lumbar muscles, and additional sutures are passed below the level of the last fixation sutures to bring together the lumbar muscles in the lower part of the incision. The suture which is immediately below the level of the kidney catches the perirenal fat, which is made to serve as a pad or bolster upon which the kidney may rest and at the same time closes the loose pouch into which the kidney was displaced. The subcutaneous fat is sutured with continuous catgut, care being taken to approximate the deep fascia and thus insure a firm line of union. The margins of the skin incision are united with an intracuticular catgut suture.

Two points are of sufficient importance to warrant emphasis. Complete hemostasis should be secured and care should be taken lest the fixation sutures constrict the ilio-inguinal and the iliohypogastric nerves, an accident which gives rise to post-operative pain.

Decortication of the Kidney for Chronic Bright's Disease.—Edebohls¹ has recommended decortication of the kidney for chronic Bright's disease. The visible changes produced by this lesion he found in the adhesions of the capsule and in the nodulation and the granular condition of the subcapsular surface. There were also variations in the density and the hardness of the kidney substance, often varying widely in different parts of the organ.

He found at secondary operations upon kidneys previously suspended that there was a great increase in the vascular supply of the kidney from the adhesions which had formed between its capsule and the surrounding tissues. He believes that the basic factor in the improvement or the cure of chronic Bright's disease following decapsulation lies in this artificial hypervascularization of the kidney. It leads to the "gradual absorption of the interstitial or intertubular inflammatory products and exudates, thus freeing the tubules and glomeruli of external compression, constriction, and distortion, and permitting the re-establishment in them of a normal circulation."

Edebohls has had fifty-one cases; nine patients apparently were permanently cured for periods varying from one year and nine months up to ten years; seventeen patients died within seven days of the operation.

¹ Edebohls, George M.: "A Cure of Chronic Bright's Disease by Operation," *Med. Record*, Dec. 21, 1901, vol. lx, p. 961; "Renal Decapsulation for Chronic Bright's Disease," *Med. Record*, Mar. 28, 1903, vol. lxiii, p. 481.

This operation is still under trial; it cannot be stated at present that decortication of the kidney will find a permanent place in the therapy of chronic Bright's disease.

The technic of the operation is the same as for nephropexy until the kidney has been delivered through the wound. The fibrous capsule of the kidney is then divided along the entire length of the convex external border and around the extremity of either pole. "Each half of the capsule proper is in turn stripped from the kidney and reflected toward the pelvis until the entire surface of the kidney lies raw and denuded before the operator. Care must be exercised not to break or tear away parts of the kidney. The stripped-off capsule is entirely cut away close to its junction with the pelvis and removed. If the kidney cannot be delivered, the capsule must be peeled off by the fingers in the bottom of the wound and excised as far as possible, any remaining part being simply reflected backward around the hilus, where it will curl up and remain. The kidney is dropped back into its fatty bed and the external incision is closed. Drainage, except when the parts are extremely edematous, is dispensed with."

Edebohls has recently recommended renal decapsulation also for puerperal eclampsia, and has reported two recoveries following the operation.

Nephrotomy.—The kidney may be exposed for nephrotomy by Edebohls', Morris', Kelly's, or Robson's incision. In an adipose subject with a very much enlarged kidney, Israel's incision may be used. The purposes of nephrotomy are to explore and drain the kidney, to relieve excessive kidney tension, and to give exit to the urine in cases of obstructive anuria.

After exposure the fatty capsule should be separated everywhere from the capsule proper of the kidney, the dissection advancing on either aspect and around both poles until the pelvis is reached. If the colon is distended, it may bulge into the wound and get into the way of the operator. This difficulty is readily overcome by pushing the bowel back with a sponge and holding it there with a deep retractor. It is desirable to deliver the kidney through the incision, and in cases uncomplicated by inflammatory changes in the perirenal tissues this presents no difficulty. The delivery of the kidney may be facilitated by gentle traction on the fatty capsule at the lower pole, by hooking the finger beneath the upper pole, and by pulling the patient downward on the Edebohls cushion.

After the organ is brought outside the incision its configuration, the regularity of its surface, and its color should be noted. The pelvis and the upper extremity

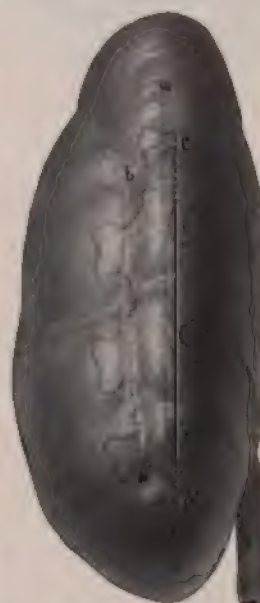


FIG. 866.—Position of the nephrotomy incision as seen from the external surface of the kidney; *b . . b'*, indicates the position of the columns of Bertini; *a . . a'*, the outer convex border of the kidney; *c . . c'*, the correct line of incision immediately posterior to the outer convex border.

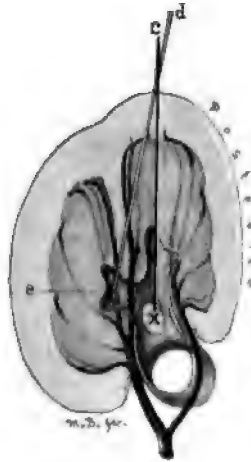


FIG. 867.—SHOWING THE CORRECT AND THE INCORRECT DIRECTION OF A NEPHROTOMY INCISION.

The line c d. cuts the most vascular area, and enters the anterior row of calyces. The line c x. opens into the posterior row, freely exposes the anterior row, and divides the kidney in its avascular part.

of the ureter should be exposed and palpated. To determine the presence of a stone or a deeply lying cyst, abscess, or tumor of the kidney, palpation between the two hands may be sufficient. Small lesions may escape observation. The use of an exploring needle at the present time is considered bad practice in cases of stone, although it may be used to determine the character of the contents of a cystic tumor. In doubtful cases suspected of stone, tumor, or tuberculous focus, the kidney should be deliberately split by an incision through Brödel's white line (Figs. 840, 866, 867, 868). By this means the kidney is divided through its least vascular area. During the procedure the amount of hemorrhage can be reduced to the minimum by compression of the renal vessels at the hilus of the kidney.

Brödel's incision opens directly into the posterior row of calyces and exposes the anterior row to sight and to palpation, so that a stone or any other lesion can scarcely be overlooked. The upper extremity of the ureter may be sounded for stone, although care should be taken lest a small calculus become impacted in the ureter.

Nephrotomy may be very difficult when there has been a fibrosclerotic inflammation of the fatty capsule. In these cases the kidney is sometimes fixed as if it were set in plaster-of-Paris, so that separation of the fatty capsule from the organ is practically impossible, and any forcible attempts to do so would be associated with great danger of tearing the neighboring organs or of lacerating the large blood-vessels in the vicinity. Under such circumstances the best plan is to cut directly through the sclerosed fatty tissue until the kidney itself is reached. Hemorrhage is likely to be free, and may be controlled either by the use of sutures or by gauze packing. If practicable, the kidney incision should be just sufficient to admit the index-finger, which will then act as a tampon during exploration of the organ.

Another difficulty in nephrotomy is caused by a distention or an enlargement of the kidney, so that it extends up under the ribs. The capsule of the kidney sac in cases of hydronephrosis, pyonephrosis, cystic disease, etc., is sometimes so thin that it may be ruptured during the operative manipulations. The possibility of rup-

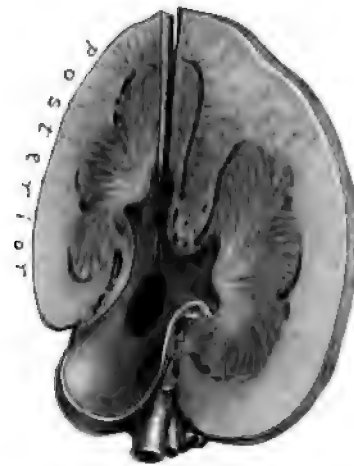


FIG. 868.—THE NEPHROTOMY INCISION COMPLETE.

Showing the posterior calyces opened, affording easy access to the anterior calyces.

ture will be lessened and delivery will be facilitated by aspiration of the fluid before attempting to separate the kidney from its fatty capsule. In some cases it will be of considerable advantage to resect the twelfth rib. To do this a vertical incision is made upward from the primary incision. There is no danger of wounding the pleura if the periosteum is divided along the posterior surface of the rib and the line of incision is kept close to the bone itself, stripping off the periosteum as the anterior surface of the rib is approached (Fig. 871). The nephrotomy incision in the case of a distended kidney should be at the thinnest part of the sac; secondary incisions may be made, if necessary.

The course of a nephrotomy operation after exposure of the kidney depends upon the lesions which are found. Thus the nephrotomy may at once become a nephrolithotomy or a nephrectomy or a partial nephrectomy. For the technic of these procedures the reader is referred to the appropriate sections. If it is desirable to maintain drainage of the renal pelvis, as in the case of an insuperable obstruction of the ureter, and nephrectomy is contraindicated by the condition of the second kidney, the operation of nephrotriosis and the formation of a permanent fistula should be employed. If the kidney is infected, drainage by means of gauze and rubber tubing should be instituted. In clean cases the divided parts of the kidney are brought together by catgut, the sutures being introduced from side to side by means of a round-pointed needle (see Fig. 869). When a permanent fistula is made, or in cases which are drained, the pressure of the drainage-tube and packing will usually control the bleeding. In clean cases a suture serves the double purpose of approximating the wound in the kidney and of arresting the hemorrhage. In clean cases the external wound should be closed.

Nephrotriosis.—Nephrotriosis is the name given by Morris to the operation for establishing a more or less permanent fistula; it is indicated when an obstruction to the outflow of urine is apt to be prolonged or constant. The first part of the operation is essentially like nephrotomy. The edges of the kidney incision are stitched either to the borders of the parietal muscles or to the divided edges

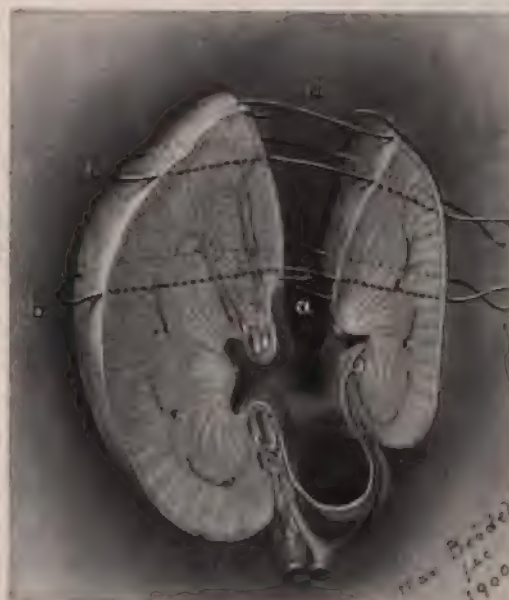


FIG. 869.—METHOD OF PASSING THE SUTURES AFTER ANASTOMOTIC NEPHROTOMY.

a, Suture uniting the margins of the divided calyces; b and c, through-and-through sutures passed with a round-pointed needle approximating the cut surfaces of the kidney tissue proper; d, suture uniting the fibrous capsule.

of the skin. The hemorrhage may be controlled by hot antiseptic solutions or by gauze packing. The renal edges should not be united to the skin unless it is desired to make the fistula permanent.

Nephrolithotomy.—The kidney may be exposed by Morris', Robson's, or Israel's incision. It should be separated from its fatty capsule and delivered through the incision, if possible. Adhesions between the fatty capsule and the kidney should be carefully separated by snipping them with scissors rather than by forcible blunt dissection, as the latter involves the risk of tearing the kidney tissue.

It may be necessary, in order to gain more room, to divide the lower edge of the ligament of Henle, which forms one of the commonest impediments to the free manipulation of the upper pole of the kidney. It is surprising to see how much difficulty is avoided if this structure is divided, as can be done easily by means of a



FIG. 870.—NEPHRECTOMY FOR TUBERCULOSIS AFTER PARTIAL RESECTION OF THE TWELFTH RIB. Note the isolation of the vessels of the pedicle and the ureter. Such a dissection of the pedicle should be made, if possible, in every nephrectomy before the ligatures are passed, each vessel being tied separately.

probe-pointed bistoury. The finger guiding the bistoury should press the tissues away from the upper part of the wound, so that there is less danger of wounding the pleura.

After the kidney is delivered or the attempt to deliver it has failed, the entire organ and the ureter should be carefully palpated to determine the position of the stone. A single stone in the cortex may be removed by a simple incision directly over it through the renal parenchyma. Stones lying entirely within the kidney pelvis may be removed, if they are small, by an incision which does not involve the

capsule is then incised along the convex border of the kidney for its entire length. When feasible, the kidney is separated from its fibrous capsule by blunt dissection with the fingers or gauze. In many cases the capsule comes off without difficulty. When the capsule has been detached down to the hilum, the pedicle may be treated in either of two ways: It may be clamped with heavy curved forceps and the kidney cut away, after which the vessels may be ligated separately, as seen in the pedicle; or, the pedicle may be transfixed with a pedicle needle carrying two ligatures and each half of the pedicle tied separately. When this plan is followed, it is best to

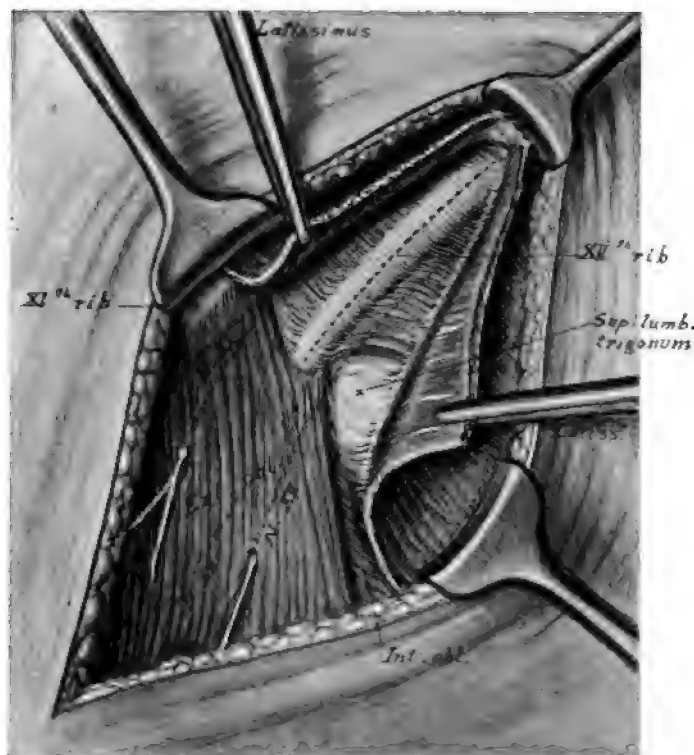


FIG. 871.—RESECTION OF TWELFTH RIB IN NEPHRECTOMY (after T. S. Cullen).

The edge of the latissimus dorsi has been located and then the muscle has been severed directly over the rib and drawn to either side. The rib and the superior lumbar trigonum are thus exposed. The periosteum of the rib is incised as indicated by the dotted line, and the bone shelled out and removed.

leave the ligatures long and to catch the pedicle with forceps before cutting away the kidney, after which the individual vessels should be separately ligated.

The ligation of the vessels in subcapsular nephrectomy is much less satisfactory than in typical nephrectomy, because of the inclusion of the kidney pelvis, which may be infiltrated. When there is much infiltration of the structures about the renal pelvis, it is better to break through the tissues of the pelvis and to separate it from the renal vessels, and to tie the vessels separately. After the kidney has been cut away, as much of the fibrous capsule and pelvis of the kidney as can safely be detached should be trimmed off. When the kidney has been removed,

by careful closure of the wound. There is little danger of wounding the pleura if its relations to the twelfth rib are borne in mind.

Nephrectomy.—Nephrectomy may be total or partial, pericapsular or subcapsular. Pericapsular nephrectomy is that form of operation in which the organ is removed with its fibrous capsule intact. In subcapsular nephrectomy the kidney is enucleated from within its fibrous capsule, which is left behind.

The kidney is exposed by means of Morris', Israel's, Robson's, or Kelly's incision. It is freed from the surrounding tissues and delivered through the incision. The vessels of the pedicle are then isolated, and a ligature is thrown around them by means of an aneurysm needle. This ligature should not include the ureter. In all cases it is wise to isolate and to apply separate ligatures to the vessels (Fig. 870), and this is particularly true if the pedicle is thick from the presence of fatty tissue. After dividing the vessels well to the renal side of the ligature, the ureter is separated as far down as desirable and divided between two ligatures, the exposed mucosa of the lower portion being carefully disinfected with carbolic acid and alcohol.

The technic described is that which will obtain in simple uncomplicated cases. When there is difficulty in separating the kidney from its surrounding structures with the finger, it is better to employ the scissors or the knife than to do much tearing. In case the pedicle of the kidney is short and surrounded by much inflammatory exudate, and in the case of a kidney tumor, it is sometimes advisable to clamp the pedicle and divide it toward the renal side before attempting to deliver the kidney; but whenever it is possible the renal vessels should be ligated before they are divided in order to make a clean excision of the kidney and to avoid slipping of the ligatures. The delivery of the kidney is sometimes facilitated by inserting the fingers of the left hand beneath the lower ribs and forcibly pulling them up. At times a resection of the twelfth rib will be of great assistance (Fig. 871). When the kidney is cystic and very much enlarged, it will expedite matters to aspirate the tumor before attempting to deliver it.

Care should be taken during nephrectomy lest the peritoneum or the colon be torn. If either of these accidents occur, the rent should be immediately closed with sutures. One of the greatest dangers incident to a nephrectomy is an overstretching of the pedicle. It may result in a rupture of the vessels or in the slipping of a ligature which has been applied to them. To avoid these accidents, when the structures at the hilus of the kidney are very much fixed, the pedicle should be clamped and divided on its renal side before the kidney is delivered.

Subcapsular nephrectomy is indicated in those cases in which the fatty capsule of the kidney is so altered by long-continued inflammation that it is extremely difficult or even impossible to separate it from the fibrous capsule of the kidney without great risk of injuring adjacent viscera, and more especially the vena cava or other great veins. The operation should be avoided in tuberculosis of the kidney and in the case of malignant tumors, as in such cases the fibrous capsule is almost necessarily involved.

The fatty capsule is exposed in the usual manner and divided. The fibrous

capsule is then incised along the convex border of the kidney for its entire length. When feasible, the kidney is separated from its fibrous capsule by blunt dissection with the fingers or gauze. In many cases the capsule comes off without difficulty. When the capsule has been detached down to the hilum, the pedicle may be treated in either of two ways: It may be clamped with heavy curved forceps and the kidney cut away, after which the vessels may be ligated separately, as seen in the pedicle; or, the pedicle may be transfixed with a pedicle needle carrying two ligatures and each half of the pedicle tied separately. When this plan is followed, it is best to

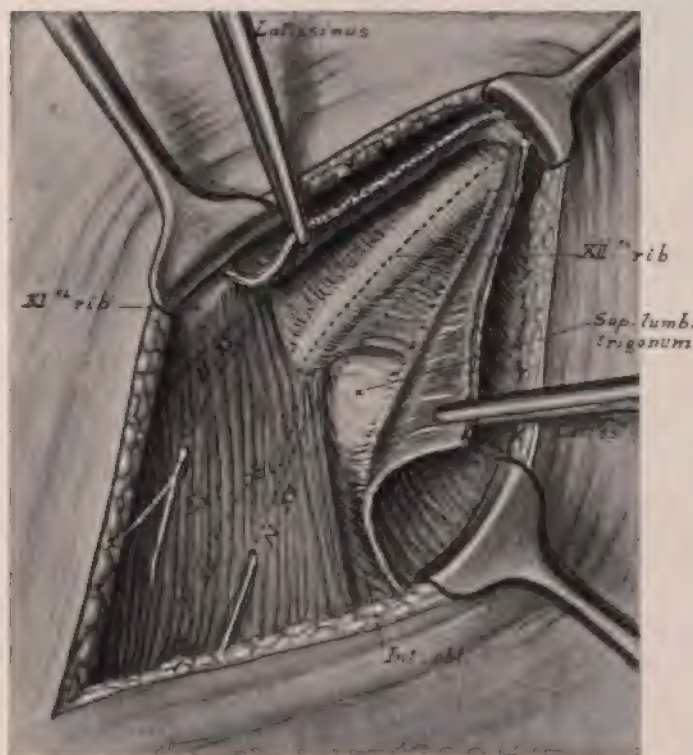


FIG. 871.—RESECTION OF TWELFTH RIB IN NEPHRECTOMY (after T. S. Cullen).

The edge of the latissimus dorsi has been located and then the muscle has been severed directly over the rib and drawn to either side. The rib and the superior lumbar triangle are thus exposed. The periosteum of the rib is incised as indicated by the dotted line, and the bone shelled out and removed.

leave the ligatures long and to catch the pedicle with forceps before cutting away the kidney, after which the individual vessels should be separately ligated.

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with the additional exposure afforded much of the fibrous capsule and pelvis of the kidney can often be excised. This procedure lessens the chances of the formation of a cyst, which is an occasional after-complication of subcapsular nephrectomy.

At times it will be found impossible to detach the kidney as a whole from its capsule. In such cases the fingers are plunged directly into the kidney tissue and the organ is removed piecemeal from within outward by breaking through the kidney parenchyma and removing one portion after another from within. In such cases more or less renal tissue may be left adherent to the fibrous capsule and more or less of it may remain as a part of the pedicle at the hilum. The ligation of the pedicle must be varied to suit the conditions in the particular case, following the principles already laid down for subcapsular nephrectomy.

Abdominal nephrectomy is used when the patient is very fat, when there is a lateral deformity of the spine, and in the case of large tumors. It is also of advantage if the condition of the second kidney is a matter of doubt.

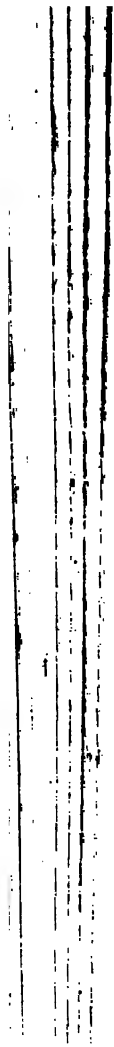
The operation should be begun by Langenbuch's incision. After determining the presence and the condition of the second kidney, the outer layer of the mesocolon on the affected side is torn through and the kidney exposed. The outer layer of the mesocolon is avascular, the nutrient vessels of the colon being placed in the inner layer. The kidney is separated from its surrounding tissues and the pedicle is tied and divided just as in lumbar nephrectomy. In an abdominal nephrectomy for tumor, if exposure of the pedicle is feasible, it should be clamped or tied before there has been much manipulation of the kidney. If drainage is required, a secondary incision should be made through the loin. The tear in the mesocolon need not be sutured unless there is some infection of the kidney. The ureter should be divided as low down as possible.

When it is especially important to control the pedicle promptly and to provide drainage, Morris adopts lumbo-abdominal nephrectomy. In this operation, after opening the abdomen and examining the opposite kidney, a piece of gauze is spread over the diseased organ from inside the abdomen and the primary incision is temporarily closed. A lumbar exposure is now made, the posterior surface of the kidney is carefully separated from its attachments, and the wound is plugged with gauze. The laparotomy incision is reopened, the peritoneum at the outer side of the colon is torn through, and the pedicle is at once isolated and tied before the separation of the kidney is completed. Delivery of the tumor through the abdominal incision may be assisted by pressing it forward through the lumbar wound. A sudden tearing away of the tumor should be especially avoided, for in one case reported by Morris this resulted in a serious hemorrhage from the rupture of a large vein which crossed the tumor. The operation is completed by closing the abdominal incision and allowing the gauze pack in the lumbar opening to remain as drainage. If the presence and the condition of the second kidney have been determined beforehand, the lumbar incision may be made first. Whenever possible abdominal nephrectomy should be avoided, as the retroperitoneal lumbar operation is much the safer, especially in inflammatory cases.

Partial nephrectomy is done for lesions which are limited to one area of the kidney. Morris has done the operation in ten cases and Kelly has recently reported a number of others. The kidney is exposed in the usual way and delivered, and the vessels at the hilum are compressed while the excision is made. The line of excision should be such that the section of renal tissue removed is wedge-shaped; this facilitates the closure of the wound. When a transverse or an oblique incision is obligatory, the surface must be left to granulate. The sutures should be passed in accordance with the principle devised by Brödel, already described.

Nephro-ureterectomy.—Nephro-ureterectomy is a combination of the operations of nephrectomy and ureterectomy. It is indicated especially in cases of tuberculosis of the kidney and ureter.

For the details of the operation see Chapter XLIII, page 744.



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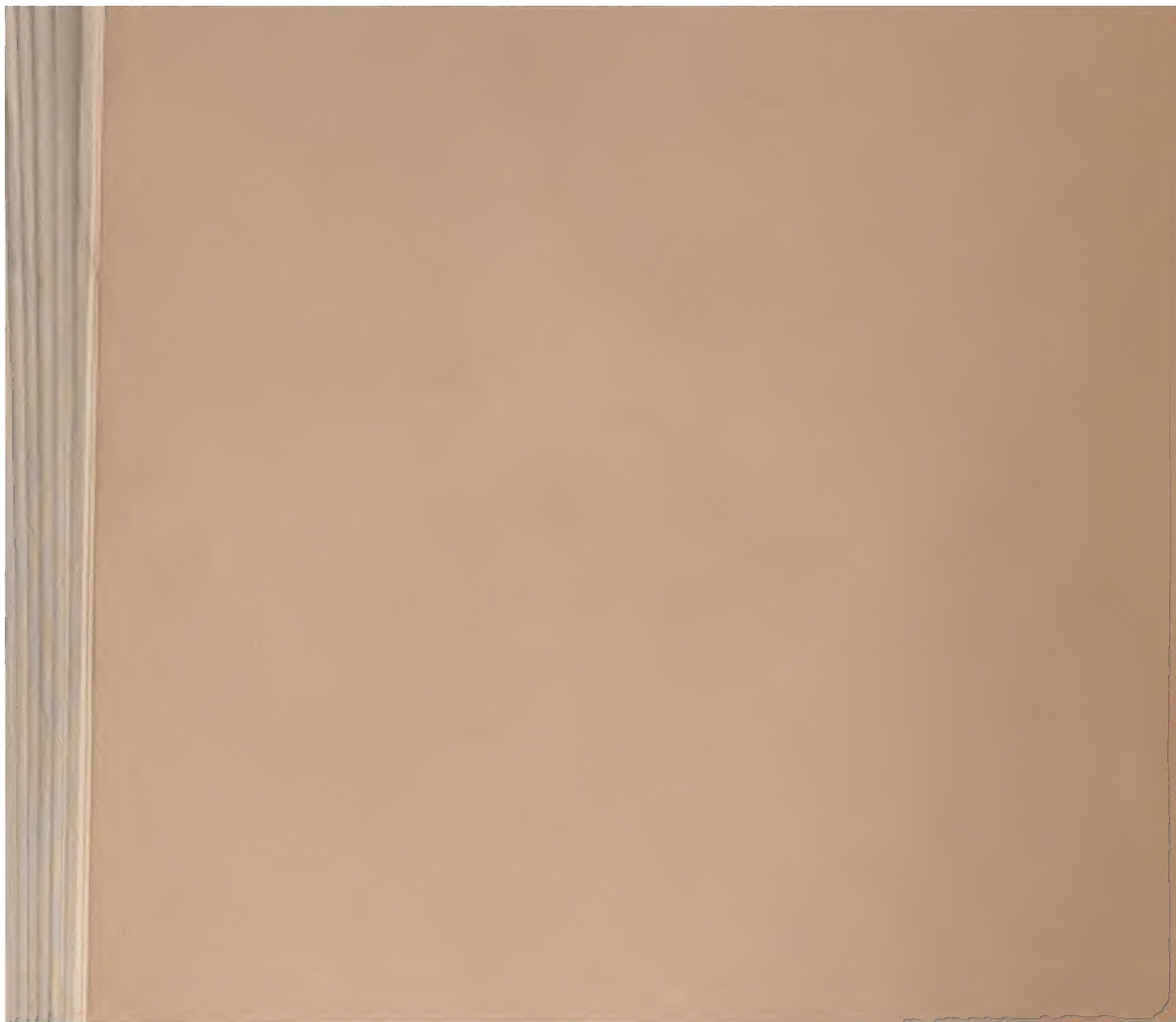
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